

MEMORY

5V-ONLY FLASH MEMORY CARD

MB98A81063-15/81183-15/81273-15/81373-15/81473-15/
81573-15/81674-20

1M/2M/4M/8M/16M/32M/64M-BYTE 5V-ONLY FLASH ERASABLE AND PROGRAMMABLE MEMORY CARD

■ DESCRIPTION

The Fujitsu 5V-Only Flash memory cards are electrically erasable and programmable memory cards capable of storing and retrieving large amounts of data. The memory circuits are housed in a credit-card sized 68-pin package. Internal circuit is protected by two metal panels, one at the top and the other at the bottom of the card, that help to reduce chip damage from electrostatic discharge.

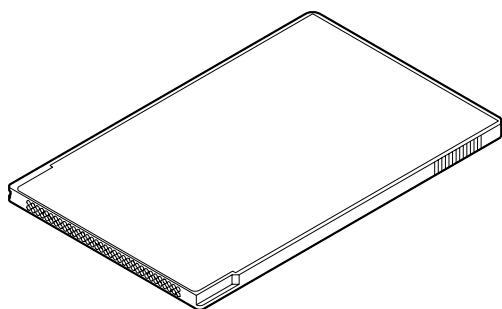
A unique feature of the Fujitsu memory cards allows the user to organize the card into either an 8-bit or a 16-bit bus configuration. All cards are portable and operate on low power at high speed.

In accordance with the Personal Computer Memory Card Internal Association (PCMCIA) and Japan Electrical Industry Development Association (JEIDA) industry standard specifications, Flash memory cards offer additional EEPROM memory that is used to store attribute data. The attribute memory is a Flash memory card option. (See page 3 for description of the three available options.)

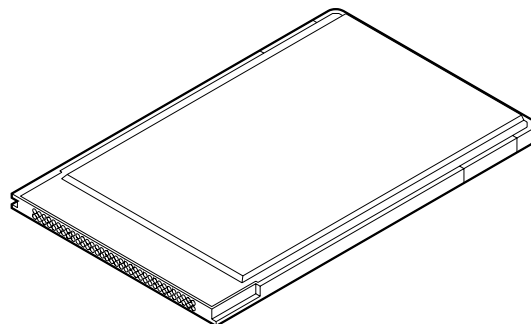
■ PRODUCT LINE & FEATURES

- Meet PCMCIA and JEIDA industry standards for 68-pin memory card
 - MB98A81063-MB98A81573:
Type I : 85.6 mm × 54.0 mm × 3.3 mm
 - MB98A81674:
Type II : 85.6 mm × 54.0 mm × 5.0 mm (Connector Portion : 3.3 mm)
- +5 V±5% power supply program and erase
- Command control for Automated Program / Automated Erase operation
- Erase Suspend Read / Program Capability (Only Erase Suspend Read is possible for MB98A81063)
- 128 KB Sector Erase (at ×16 mode)
- Any Combination of Sectors Erase and Full Chip Erase
- Detection of completion of program/erase operation with $\overline{\text{Data}}$ Polling or Toggle bit.
- Ready/Busy Output with R/ $\overline{\text{B}}$ (Except for MB98A81063)
- Reset Function with RESET pin (Except for MB98A81063)
- Write protect function with WP switch (Except for MB98A81674)
- Low V_{cc} Write Inhibit

■ PACKAGE



CRD-68P-M17
(MB98A81063-81573)



CRD-68P-M29
(MB98A81674)

MB98A81063-15/81183-15/81273-15/81373-15/81473-15/81573-15/81674-20

■ DESCRIPTIONS

DESCRIPTION TABLE

Part Number	Common Memory			Attribute Memory		
	Memory Device	Organization (W × bit)	Access Time	Memory Device	Organization (W × bit)	Access Time
MB98A81063	4M bit Flash Memory × 2	1M × 8/512K × 16	150 ns max.	16K bit EEPROM × 1	2K × 8	250 ns max.
MB98A81183	8M bit Flash Memory × 2	2M × 8/1M × 16				
MB98A81273	16M bit Flash Memory × 2	4M × 8/2M × 16				
MB98A81373	16M bit Flash Memory × 4	8M × 8/4M × 16				
MB98A81473	16M bit Flash Memory × 8	16M × 8/8M × 16				
MB98A81573	16M bit Flash Memory × 16	32M × 8/16M × 16				
MB98A81674	16M bit Flash Memory × 32	64M × 8/32M × 16	200 ns max.			

DIFFERENCES

	MB98A81063	MB98A81183	MB98A81273	MB98A81373	MB98A81473	MB98A81573	MB98A81674
Density	1MB	2MB	4MB	8MB	16MB	32MB	64MB
Memory Device	4M bit	8M bit	16M bit	←	←	←	←
Quantity	2	2	2	4	8	16	32
Read	1 B unit	←	←	←	←	←	←
Program	1 B unit	←	←	←	←	←	←
Chip Erase	512 KB unit	1 MB unit	2 MB unit	←	←	←	←
Sector Erase	64 KB unit	←	←	←	←	←	←
Number of Sectors	16	32	64	128	256	512	1024
Erase Suspend Read	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Erase Suspend Program	No	Yes	Yes	Yes	Yes	Yes	Yes
Address	A ₀ to A ₁₉	A ₀ to A ₂₀	A ₀ to A ₂₁	A ₀ to A ₂₂	A ₀ to A ₂₃	A ₀ to A ₂₄	A ₀ to A ₂₅
RESET	No	Yes	Yes	Yes	Yes	Yes	Yes
R/ \bar{B}	No	Yes	Yes	Yes	Yes	Yes	Yes

■ DESCRIPTIONS (Continued)

ADDRESS MAP (for × 16 mode, not contained A₀)

1FFFFFFh							chip31, 30
1DFFFFFFh							chip29, 28
1BFFFFFFh							chip27, 26
19FFFFFFh							chip25, 24
17FFFFFFh							chip23, 22
15FFFFFFh							chip21, 20
13FFFFFFh							chip19, 18
11FFFFFFh							chip17, 16
FFFFFFh						chip15, 14	chip15, 14
DFFFFFFh						chip13, 12	chip13, 12
BFFFFFFh						chip11, 10	chip11, 10
9FFFFFFh						chip9, 8	chip9, 8
7FFFFFFh				chip7, 6	chip7, 6	chip7, 6	chip7, 6
5FFFFFFh				chip5, 4	chip5, 4	chip5, 4	chip5, 4
3FFFFFFh			chip3, 2	chip3, 2	chip3, 2	chip3, 2	chip3, 2
1FFFFFFh		chip1, 0	chip1, 0	chip1, 0	chip1, 0	chip1, 0	chip1, 0
0FFFFFFh	chip1, 0	chip1, 0					
07FFFFFFh							
000000h							
	MB98A81063	MB98A81183	MB98A81273	MB98A81373	MB98A81473	MB98A81573	MB98A81674

■ PIN ASSIGNMENTS

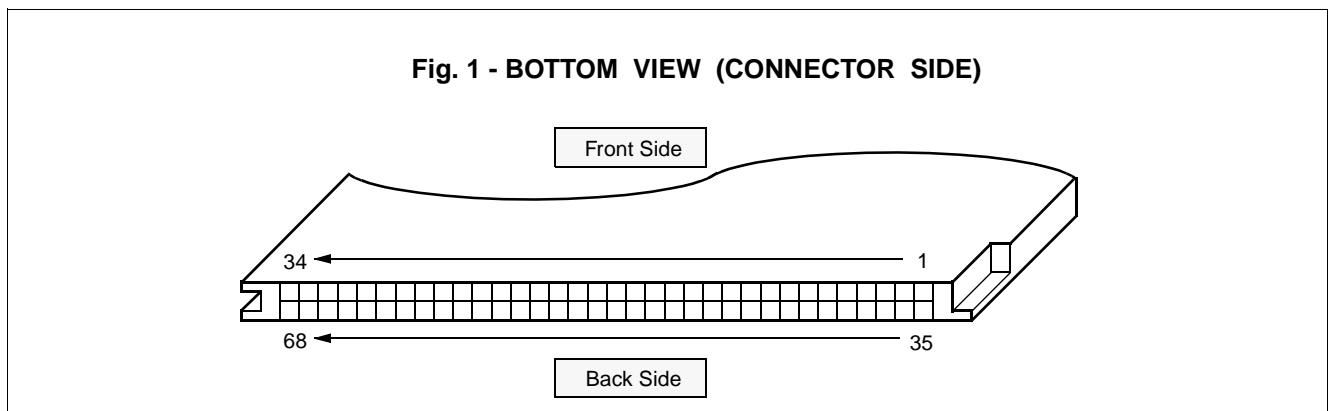
Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol
1	GND	18	N.C.	35	GND	52	N.C.
2	D ₃	19	A ₁₆	36	$\overline{CD1}$	53	A ₂₂ /N.C.*
3	D ₄	20	A ₁₅	37	D ₁₁	54	A ₂₃ /N.C.*
4	D ₅	21	A ₁₂	38	D ₁₂	55	A ₂₄ /N.C.*
5	D ₆	22	A ₇	39	D ₁₃	56	A ₂₅ /N.C.*
6	D ₇	23	A ₆	40	D ₁₄	57	N.C.
7	$\overline{CE1}$	24	A ₅	41	D ₁₅	58	RESET/N.C.
8	A ₁₀	25	A ₄	42	$\overline{CE2}$	59	N.C.
9	\overline{OE}	26	A ₃	43	N.C.	60	N.C.
10	A ₁₁	27	A ₂	44	N.C.	61	\overline{REG}
11	A ₉	28	A ₁	45	N.C.	62	BVD2
12	A ₈	29	A ₀	46	A ₁₇	63	BVD1
13	A ₁₃	30	D ₀	47	A ₁₈	64	D ₈
14	A ₁₄	31	D ₁	48	A ₁₉	65	D ₉
15	\overline{WE}	32	D ₂	49	A ₂₀ /N.C.*	66	D ₁₀
16	R/B/N.C.*	33	WP	50	A ₂₁ /N.C.*	67	$\overline{CD2}$
17	V _{CC}	34	GND	51	V _{CC}	68	GND

* : See "DESCRIPTIONS".

■ PIN DESCRIPTIONS

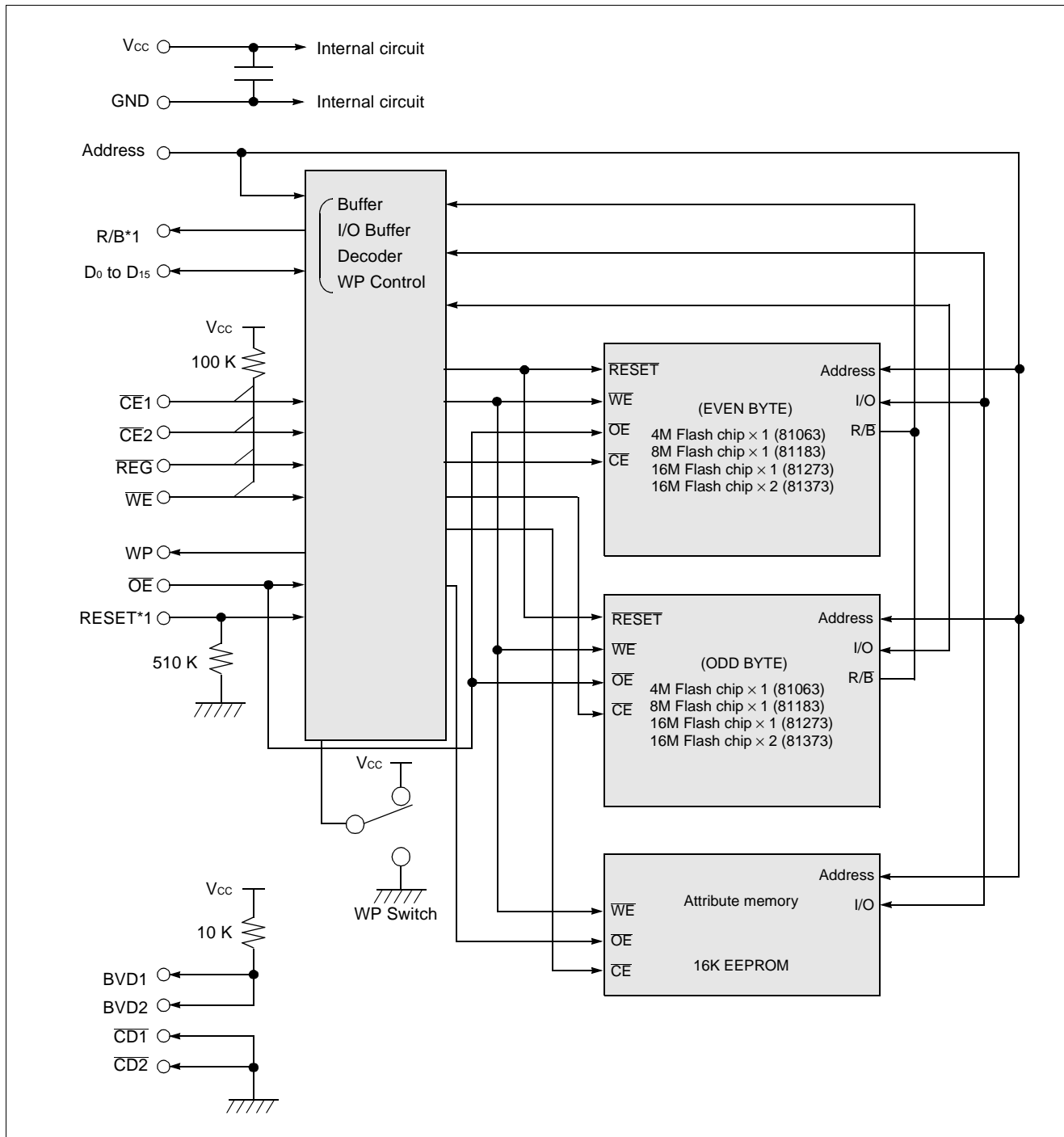
Symbol	Pin Name	Input/Output	Function
A ₀ to A ₂₅	Address Input	Input	Address Inputs, A ₀ to A ₂₅ .
D ₀ to D ₁₅	Data Input/Output	Input/Output	Data Inputs/Outputs. This data bus size (8-bit or 16-bit) is selected with CE1 and CE2.
$\overline{\text{CE1}}$	Card Enable for Lower Byte	Input	Active Low. -Lower byte (D ₀ to D ₇) is selected for read/write/erase function of flash memory cards.
$\overline{\text{CE2}}$	Card Enable for Upper Byte	Input	Active Low. -Upper byte (D ₈ to D ₁₅) is selected for read/write/erase function of flash memory cards.
$\overline{\text{REG}}$	Attribute Memory Select	Input	Active Low. -Attribute memory is selected for read/write function of identification data of flash memory cards. (N.C. or "FF" data or attribute data.)
$\overline{\text{OE}}$	Output Enable	Input	Active Low. -Output enable for flash memory cards.
$\overline{\text{WE}}$	Write Enable	Input	Active Low. -Write enable for flash memory cards.
$\overline{\text{CD1}}$, $\overline{\text{CD2}}$	Card Detect	Output	These pins detect if the card has been correctly inserted. Both pins are tied to GND internally.
WP	Write Protect	Output	Write controller for flash memory cards. This pin outputs the Protect/Non Protect status of "WP Switch".
BVD1, BVD2	Battery Voltage Detect	Output	Both pins are tied to V _{CC} internally.
RESET	Hardware Reset	Input	The card may be reset by driving the RESET pin to V _{IH} .
R/ $\overline{\text{B}}$	Ready/Busy	Output	System can be detect the completion of program or erase operation.
V _{CC}	Power Supply	—	Power Supply Voltage. (+5.0 V \pm 5%)
GND	Ground	—	System Ground.
N.C.	Non Connection	—	

■ PIN LOCATIONS



■ BLOCK DIAGRAM

MB98A81063, MB98A81183, MB98A81273 and MB98A81373



*1: Not available for MB98A81063.

Fig. 2.1 - Block Diagram

■ BLOCK DIAGRAM (Continued)

MB98A81473, MB98A81573 and MB98A81674

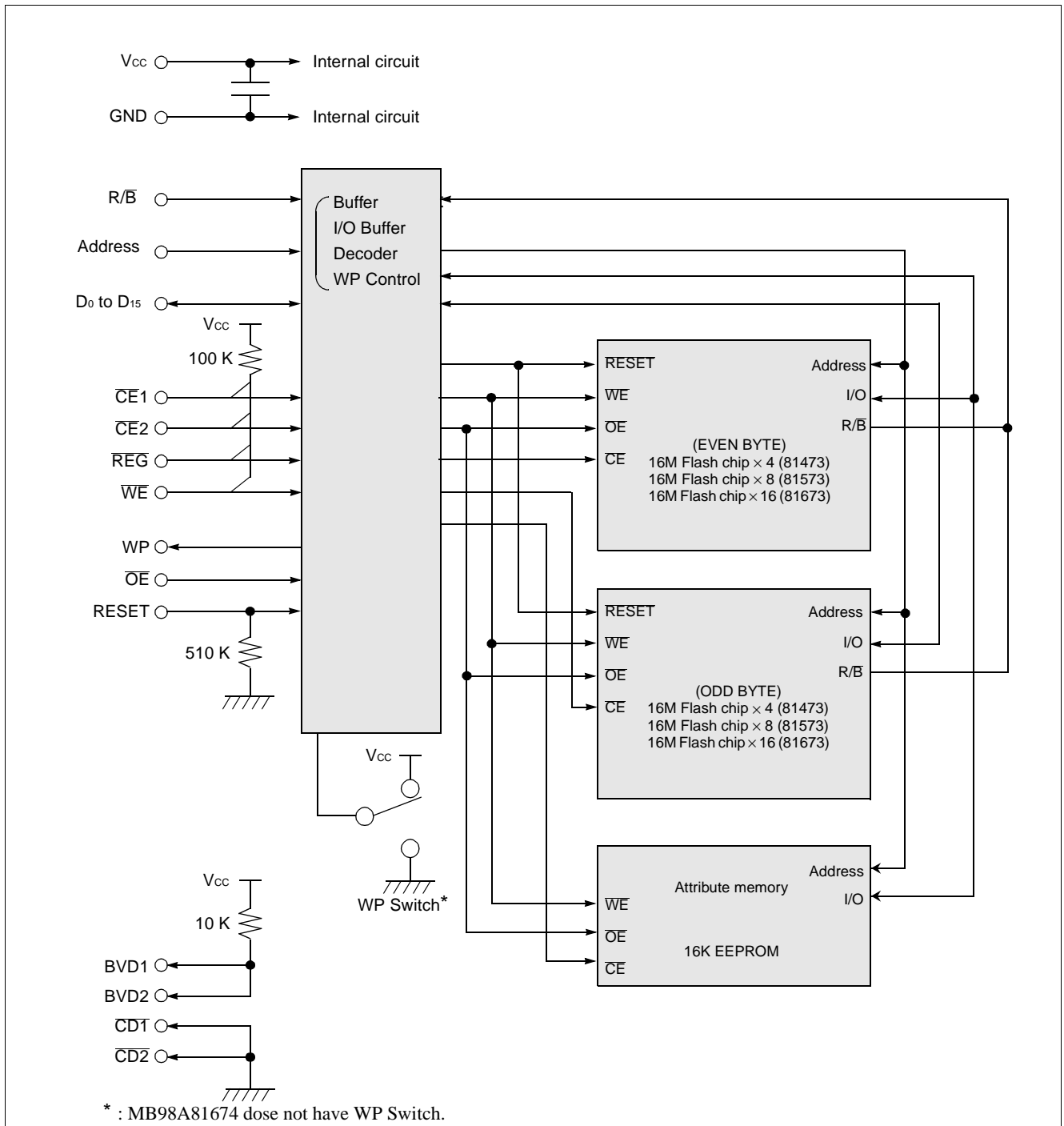


Fig. 2.2 - Block Diagram

MB98A81063-15/81183-15/81273-15/81373-15/81473-15/81573-15/81674-20

■ CHIP AND SECTOR DECODING

- Chip can be selected with;
 - A₀, A₂₂, A₂₃, A₂₄ and A₂₅ for × 8-bit mode No.1.
 - A₂₂, A₂₃, A₂₄ and A₂₅ for × 8-bit mode No.2 and × 16-bit mode.
- Sector per each chip can be selected with A₁₇, A₁₈, A₁₉, A₂₀ and A₂₁.

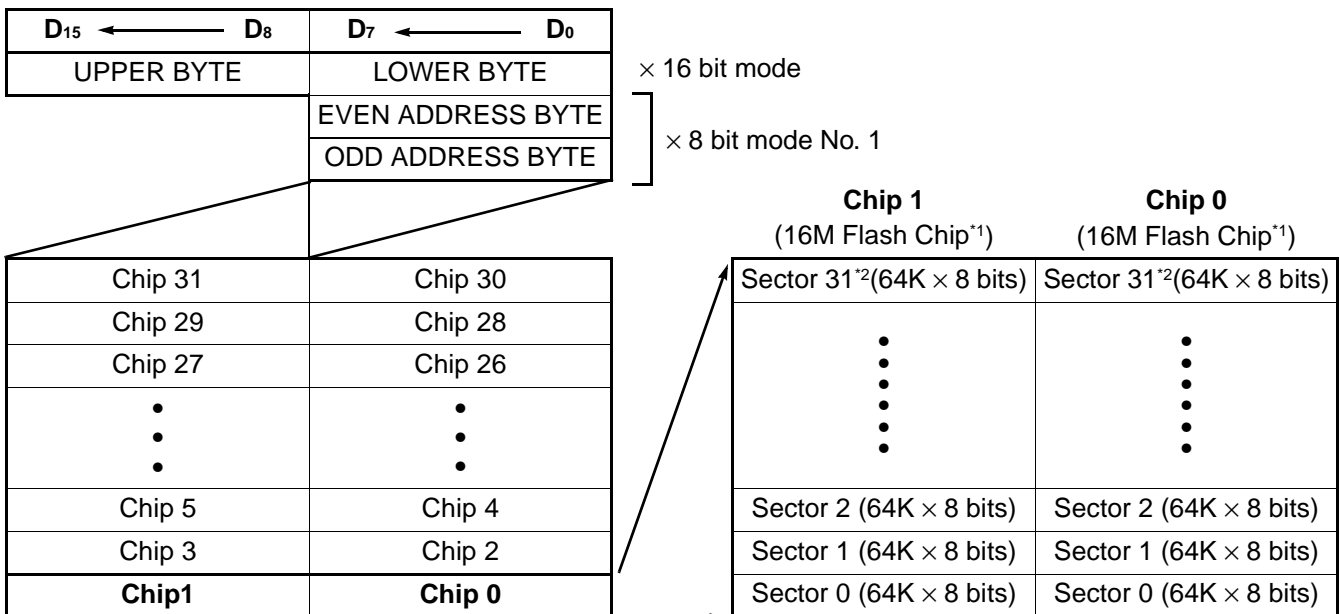
ERASE SECTOR DECODING TABLE

	Sector Address (SA)				
	A ₂₁ *2	A ₂₀ *1	A ₁₉	A ₁₈	A ₁₇
Sector 31	1	1	1	1	1
Sector 30	1	1	1	1	0
Sector 29	1	1	1	0	1
•	•	•	•	•	•
•	•	•	•	•	•
•	•	•	•	•	•
•	•	•	•	•	•
•	•	•	•	•	•
•	•	•	•	•	•
Total 32 sectors*1*2 per 1 chip					
Sector 2	0	0	0	1	0
Sector 1	0	0	0	0	1
Sector 0	0	0	0	0	0

*1: A₂₀ is not available for MB98A81063. MB98A81063 has 8 sectors.

*2: A₂₁ is not available for MB98A81063 and MB98A81183. MB98A81063 has 8 sectors and MB98A81183 has 16 sectors.

CARD CHIP / SECTOR CONFIGURATION



Card Chip Configuration for 64MB Card

Sector Configuration for 2 Chips

*1: 4M Flash Chip for MB98A81063. 8M Flash chip for MB98A81183.

*2: Sector 7 for MB98A81063. Sector 15 for MB98A81183.

■ FUNCTION DESCRIPTIONS

1. Read Mode

The data in the common and attribute memory can be read with " $\overline{OE}=V_{IL}$ " and " $\overline{WE}=V_{IH}$ ". The address is selected with A_0 to A_{25} . And $\overline{CE1}$ and $\overline{CE2}$ select output mode ($\times 8/\times 16$ output mode, See "FUNCTION TRUTH TABLES"). The following 1) and 2) are the descriptions for Common Memory Read and Attribute Memory Read mode.

(1) Common Memory Read

- Two modes of Common Memory Read, reading the data in memory array and Intelligent ID are available. The card enter each Read mode by writing "Read Memory/Reset Command" or "Intelligent ID Read Command". The card automatically resets to the condition of Common Memory Read mode upon initial power-up.

(2) Attribute Memory Read

- The data on the attribute memory can be read with " $\overline{REG}=V_{IL}$ ", " $\overline{OE}=V_{IL}$ " and " $\overline{WE}=V_{IH}$ ".
- An address on attribute memory can be selected with A_0 to A_{11} pin. And $\overline{CE1}$ and $\overline{CE2}$ select output mode.

2. Standby Mode

- $\overline{CE1}$ and $\overline{CE2}$ at " V_{IH} " place the card in Standby mode. D_0 to D_{15} are placed in a high-Z state independent of the status " \overline{OE} ", " \overline{WE} " and " \overline{REG} ".

3. Output Disable Mode

- The outputs are disabled with \overline{OE} and \overline{WE} at " V_{IH} ". D_0 to D_{15} are placed in high-Z state.

4. Write Mode

(1) Common Memory Write

- The card is in Write mode with " $\overline{OE}=V_{IH}$ " and " \overline{WE} and $\overline{CE}=V_{IL}$ ".
- Commands can be written at the Write mode. See "5.Command Definitions".
- Two types of the Write mode, " \overline{WE} control" and " \overline{CE} control" are available.

(2) Attribute Memory Write

- \overline{REG} at L-level selects Attribute memory and " $\overline{OE}=V_{IH}$ ", " \overline{WE} and $\overline{CE}=V_{IL}$ " place it in write mode. Two types of the write mode, " \overline{WE} control" and " \overline{CE} control" are available.
- Attribute memory is not controlled by writing Commands. And attribute memory has the \overline{Data} polling function, which can detect whether the attribute memory status is in programming operation. When the read operation is executed at programming cycle, the opposite data is output from D_7 ($\overline{I7}$), and the same data (O_7) as the written data is output from D_7 pin at the completion of programming operation.

5. Command Definitions

- User can select the card operation by writing the specific address and data sequences into the command register. If incorrect address and data are written or improper sequence is done, the card is reseted to read mode. See "COMMAND DEFINITION TABLE".

6. Automated Program Capability

- Programming operation can switch the data from "1" to "0".
- The data is programmed on a byte-by-byte or word-by-word basis.
- The card will automatically provide adequate internally generated programming pulses and verify the programmed cell margin by writing four bus cycle operation. The card returns to Common Memory Read mode automatically after the programming is completed.
- Addresses are latched at falling edge of \overline{WE} or \overline{CE} and data is latched at rising edge of \overline{WE} or \overline{CE} . The fourth rising edge of \overline{WE} or \overline{CE} on the command write cycle begins programming operation.
- We can check whether a byte (word) programming operation is completed successfully by sequence flug with R/\overline{B} (Except for MB98A81063), \overline{Data} Polling or Toggle Bit function. See "WRITE OPERATION STATUS".
- Any commands written to the chip during programming operation will be ignored.

7. Automated Chip Erase Capability

- We can execute chip erase operation by 6 bus cycle operation. Chip erase does not require the user to pre-program prior to erase. Upon executing the Erase command sequence the chip automatically will program and verify the entire memory for an all zero data pattern prior to electrical erase. The system is not required to provide any controls or timing during these operations.
- The card returns to Common Memory Read mode automatically after the chip erasing is completed.

■ FUNCTION DESCRIPTIONS (Continued)

- Whether or not chip erase operation is completed successfully can be checked by sequence flug with R/ \bar{B} (Except for MB98A81063), Data Polling or Toggle Bit function. See "WRITE OPERATION STATUS".
- Any commands written to the chip during programming operation will be ignored.

8. Automated Sector Erase Capability

- We can execute the erase operation on any sectors by 6 bus cycle operation.
- A time-out of 50 μ s (typ.) from the rising edge of the last Sector Erase command will initiate the Sector Erase command(s) for other sector than the sector that sector erase command have been valid.
- Multiple sectors in a chip can be erased concurrently. This sequence is followed with writes of 30H to addresses in other sectors desired to be concurrently erased. The time between writes 30H must be less than 50 μ s, otherwise that command will not be accepted. Any command other than Sector Erase or Erase Suspend during this time-out period will reset the chip to Read mode. The automated sector erase begins after the 50 μ s (typ.) time out from the rising edge of \overline{WE} pulse for the last Sector Erase command pulse. Whether the sector erase window is still open can be monitored with D_3 and D_{11} .
- Sector Erase does not require the user to pre-program prior to erase. The chip automatically programs "0" to all memory locations in the sector(s) prior to electrical erase. The system is not required to provide any controls or timing during these operations.
- The card returns to Common Memory Read mode automatically after the sector erasing is completed.
- Whether or not sector erase operation is completed successfully can be checked by sequence flug with R/ \bar{B} , Data Polling or Toggle Bit function. The sequence flug must be read from the address of the sector involved in erase operation. See "WRITE OPERATION STATUS".

9. Erase Suspend

- Erase Suspend command allows the user to interrupt the sector erase operation and then do data reads or program from or to a non-busy sector in the chip which has the sector(s) suspended erase (only data read is possible for MB98A81063). This command is applicable only during the sector erase operation (including the sector erase time-out period after the sector erase commands 30H) and will be ignored if written during the chip erase or programming operation. Writing this command during the time-out will result in immediate termination of the time-out period. The addresses are "don't cares" in writing the Erase Suspend or Resume commands in the chip.
- When the Erase Suspend command is written during a Sector Erase operation, the chip will enter the Erase Suspend Read mode. User can read the data from other sectors than those in suspension. The read operation from sectors in suspension results D_2/D_{10} toggling for MB98A81183 and MB98A8xx7x. User can program to non-busy sectors by writing program commands for MB98A81183 and MB98A8xx7x.
- A read from a sector being erase suspended may result in invalid data.

10. Intelligent Identifier (ID) Read Mode

- Each common memory can execute an Intelligent Identifier operation, initiated by writing Intelligent ID command (90H). Following the command write, a read cycle from address 00H retrieves the manufacture code, and a read cycle from address 01H returns the device code as follows. To terminate the operation, it is necessary to write Read/Reset command.

Part Number	Maker Code	Device Code
MB98A81063	04 h / 0404 h	A4 h / A4A4 h
MB98A81183	04 h / 0404 h	D5 h / D5D5 h
MB98A81273/81373/1473/81573/81674	04 h / 0404 h	3D h / 3D3D h

11. Hardware Reset (not applied for MB98A81063)

- The Card may be reset by driving the RESET pin to V_{IH} . The RESET pin must be kept High (V_{IH}) for at least 500 ns. Any operation in progress will be terminated and the card will be reset to the read mode 20 μ s after the RESET pin is driven High. If a hardware reset occurs during a program operation, the data at that particular location will be indeterminate.
- When the RESET pin is high and the internal reset is complete, the Card goes to standby mode and cannot be accessed. Also, note that all the data output pins are High-Z for the duration of the RESET pulse. Once the RESET pin is taken low, the Card requires 500 ns of wake up time until outputs are valid for read access.
- If hardware reset occurs during a erase operation, there is a possibility that the erasing sector(s) cannot be used after this.

MB98A81063-15/81183-15/81273-15/81373-15/81473-15/81573-15/81674-20

■ FUNCTION DESCRIPTIONS (Continued)

12. Data Protection

- The card has WP (Write Protect) switch for write lockout.(Except for MB98A81674)
- To avoid initiation of a write cycle during V_{CC} power-up and power-down, a write cycle is locked out for V_{CC} less than 3.2 V (typically 3.7 V). If $V_{CC} < V_{LKO}$, the command register is disabled and all internal program/erase circuits are disabled. Under this condition the device will reset to the read mode. Subsequent writes will be ignored until the V_{CC} level is greater than V_{LKO} . It is the users responsibility to ensure that the control pins are logically correct to prevent unintentional writes when V_{CC} is above 3.2 V.
- If V_{CC} would be less than V_{LKO} during program/erase operation, the operation will stop. And after that, the operation will not resume even if V_{CC} returns recommended voltage level. Therefore, program command must be written again because the data on the address interrupted program operation is invalid. And regarding interrupting erase operation, there is possibility that the erasing sector(s) cannot be used.
- Noise pulses of less than 5 ns (typical) on OE, CE or WE will not initiate a write cycle.

■ FUNCTION TRUTH TABLE

MAIN MEMORY FUNCTION*1

Mode	RESET*3	REG	CE2	CE1	A ₀	OE	WE	WP*2	Data Input/Output		WP SW*4										
									D ₈ to D ₁₅	D ₀ to D ₇											
Hardware Reset	H	X	X	X	X	X	X	X	High-Z		P or NP										
Standby	L	X	H	H	X	X	X	X	High-Z												
Read (×8 No.1)		H	L	L	L	L	H	X	High-Z	D _{OUT} (Even Byte)											
Read (×8 No.1)					H					D _{OUT} (Odd Byte)											
Read (×8 No.2)					L					H		X	D _{OUT} (Odd Byte)	High-Z							
Read (×16)										L		D _{OUT}									
Write (×8 No.1)					H					L		L	L	H	L	L	High-Z	D _{IN} (Even Byte)	NP		
Output Disable													H					High-Z	P		
Write (×8 No.1)		H	H	H		D _{IN} (Odd Byte)	NP														
Output Disable				H		High-Z	P														
Write (×8 No.2)		L	H	X		L	D _{IN} (Odd Byte)	High-Z	NP												
Output Disable						H	High-Z	P													
Write (×16)						L	D _{IN}		NP												
Output Disable						H	High-Z		P												
Output Disable						X	X	X	X				H					H	X	High-Z	

Notes:

*1: H = V_{IH} , L = V_{IL} , X = Either V_{IL} or V_{IH} , WP SW = Write Protect Switch, P = Protect, NP = Non Protect

*2: L-level is output when WPSW = NP. H-level is output when WPSW = P.

L-level is always output for MB98A81674.

*3: Not available for MB98A81063.

*4: Not available for MB98A81674.

■ COMMAND DEFINITION TABLE

Command table for 8-bit Mode

Command	Bus Cycle	1st Bus Write Cycle		2nd Bus Write/Read Cycle		3rd Bus Write Cycle		4th Bus Write/Read Cycle		5th Bus Write Cycle		6th Bus Write Cycle	
Read/Reset 1	2	Write		Read									
		CA	F0H	RA	RD								
Read/Reset 2	4	Write		Write		Write		Read					
		RCMA1	AAH	RCMA2	55H	RCMA1	F0H	RA	RD				
Read Intelligent ID Codes	4	Write		Write		Write		Read					
		ICMA1	AAH	ICMA2	55H	ICMA1	90H	IA	ID				
Byte Program	4	Write		Write		Write		Write					
		PCMA1	AAH	PCMA2	55H	PCMA1	A0H	PA	PD				
Sector Erase	6	Write		Write		Write		Write		Write		Write	
		SCMA1	AAH	SCMA2	55H	SCMA1	80H	SCMA1	AAH	SCMA2	55H	SA	30H
Chip Erase	6	Write		Write		Write		Write		Write		Write	
		CCMA1	AAH	CCMA2	55H	CCMA1	80H	CCMA1	AAH	CCMA2	55H	CCMA1	10H
Sector Erase Suspend	1	Write											
		CA	B0H										
Sector Erase Resume	1	Write											
		CA	30H										

Notes:

CA: Chip Address. (address in chip selected by A₀, A₂₂, A₂₃, A₂₄ and A₂₅)
 SA: Sector Address (address in 64 KB selected by A₀, A₁₇, A₁₈, A₁₉, A₂₀, A₂₁, A₂₂, A₂₃, A₂₄ and A₂₅)
 PA: Program Address (address to be programmed)
 RA: Read Address (address to be read)
 IA: Intelligent ID read address (Manufacture Code 0000H, Device Code 0002H)

PD: Programming data

RD: Read data

ID: Intelligent Identifier (ID) Code

CCMA1, CCMA2: Command address for chip erase
 SCMA1, SCMA2: Command address for sector erase
 PCMA1, PCMA2: Command address for program
 RCMA1, RCMA2: Command address for Read/Reset
 ICMA1, ICMA2: Command address for intelligent ID read

See "Command Address Table for 8-bit Mode" in page 16.

Command Table for 16-bit Mode*1

Command	Bus Cycle	1st Bus Write Cycle		2nd Bus Write/Read Cycle		3rd Bus Write Cycle		4th Bus Write/Read Cycle		5th Bus Write Cycle		6th Bus Write Cycle	
Read/Reset 1	2	Write		Read									
		—	F0F0H	RA	RD								
Read/Reset 2	4	Write		Write		Write		Read					
		RCMA1	AAAAH	RCMA2	5555H	RCMA1	F0F0H	RA	RD				
Read Intelligent ID Codes	4	Write		Write		Write		Read					
		ICMA1	AAAAH	ICMA2	5555H	ICMA1	9090H	IA	ID				
Byte Program	4	Write		Write		Write		Write					
		PCMA1	AAAAH	PCMA2	5555H	PCMA1	A0A0H	PA	PD				
Sector Erase	6	Write		Write		Write		Write		Write		Write	
		SCMA1	AAAAH	SCMA2	5555H	SCMA1	8080H	SCMA1	AAAAH	SCMA2	5555H	SA	3030H
Chip Erase	6	Write		Write		Write		Write		Write		Write	
		CCMA1	AAAAH	CCMA2	5555H	CCMA1	8080H	CCMA1	AAAAH	CCMA2	5555H	CCMA1	1010H
Sector Erase Suspend	1	Write											
		CA	BOB0H										
Sector Erase Resume	1	Write											
		CA	3030H										

Notes:

CA: Chip Address. (address in chip selected by A₂₂, A₂₃, A₂₄ and A₂₅)
SA: Sector Address (address in 128 KB selected by A₁₇, A₁₈, A₁₉, A₂₀, A₂₁, A₂₂, A₂₃, A₂₄ and A₂₅)
PA: Program Address (address to be programmed)
RA: Read Address (address to be read)
IA: Intelligent ID read address (Manufacture Code 0000H, Device Code 0001H)

PD: Programming data
RD: Read data
ID: Intelligent Identifier (ID) Code

CCMA1, CCMA2: Command address for chip erase
SCMA1, SCMA2: Command address for sector erase
PCMA1, PCMA2: Command address for program
RCMA1, RCMA2: Command address for Read/Reset
ICMA1, ICMA2: Command address for intelligent ID read

See "Command Address Table for 16-bit Mode" in page 16.

*1: Address number is not contained "A₀".

MB98A81063-15/81183-15/81273-15/81373-15/81473-15/81573-15/81674-20

■ COMMAND DEFINITION TABLE (Continued)

Command Address Table for 8-bit Mode

Command Address	MB98A81063	MB98A81183	MB98A81273, 81373, 81473, 81573, 81674
CCMA1	(CA AND 000001h) OR AAAAh	(CA AND 000001h) OR AAAh	CA
CCMA2	(CA AND 000001h) OR 5554h	(CA AND 000001h) OR 554h	CA
SCMA1	(SA AND 000001h) OR AAAAh	(SA AND 000001h) OR AAAh	CA
SCMA2	(SA AND 000001h) OR 5554h	(SA AND 000001h) OR 554h	CA
PCMA1	(PA AND 000001h) OR AAAAh	(PA AND 000001h) OR AAAh	CA
PCMA2	(PA AND 000001h) OR 5554h	(PA AND 000001h) OR 554h	CA
RCMA1	(RA AND 000001h) OR AAAAh	(RA AND 000001h) OR AAAh	CA
RCMA2	(RA AND 000001h) OR 5554h	(RA AND 000001h) OR 554h	CA
ICMA1	(IA AND 000001h) OR AAAAh	(IA AND 000001h) OR AAAh	CA
ICMA1	(IA AND 000001h) OR 5554h	(IA AND 000001h) OR 554h	CA

Command Address Table for 16-bit Mode

Command Address	MB98A81063	MB98A81183	MB98A81273, 81373, 81473, 81573, 81674
CCMA1	5555h	555h	CA
CCMA2	2AAAh	2AAh	CA
SCMA1	5555h	555h	CA
SCMA2	2AAAh	2AAh	CA
PCMA1	5555h	555h	CA
PCMA2	2AAAh	2AAh	CA
RCMA1	5555h	555h	CA
RCMA2	2AAAh	2AAh	CA
ICMA1	5555h	555h	CA
ICMA1	2AAAh	2AAh	CA

■ WRITE OPERATION STATUS

Hardware Sequence Flag Table

Status		D ₇ , D ₁₅	D ₆ , D ₁₄	D ₅ , D ₁₃	D ₃ , D ₁₁	D ₂ , D ₁₀ *4	R/B*4	
In Progress	Programming	$\overline{D}_7, \overline{D}_{15}$	Toggle	0	0	1	0	
	Erasing	0	Toggle	0	1	Toggle	0	
	Erase Suspend Read	(1)	1	1	0	0	*1	1
		(2)	Data	Data	Data	Data	Data	1
	Erase Suspend*4 Program	$\overline{D}_7, \overline{D}_{15}$	*2	0	0	*1, *3	0	
Exceeded Time Limits	Programming	$\overline{D}_7, \overline{D}_{15}$	Toggle	1	0	1	0	
	Erasing	0	Toggle	1	1	N/A	0	
	Erase Suspend*4 Program	$\overline{D}_7, \overline{D}_{15}$	Toggle	1	0	N/A	0	

Notes:

(1): Erase Suspended Sector (2): Non-Erase Suspended Sector

*1. Performing successive read operations from the erase-suspended sector will cause D₂, D₁₀ to toggle.

*2. Performing successive read operations from any address will cause D₆, D₁₄ to toggle.

*3. Reading the byte address being programmed while in the erase-suspend program mode will indicate logic "1" at the D₂, D₁₀ bit. However, successive reads from the erase-suspended sector will cause D₂, D₁₀ to toggle.

*4. Not applied for MB98A81063.

D₇, D₁₅ ($\overline{\text{Data}}$ Polling)

The card features $\overline{\text{Data}}$ Polling as a method to indicate to the host that the Program/Erase Operation are in progress or completed. During the program operation an attempt to read the program address will produce the compliment of the data last written to D₇/D₁₅. Upon completion of the program operation, an attempt to read the program address will produce the true data last written to D₇/D₁₅. During the erase operation, an attempt to read the erase address will produce a "0" at the D₇/D₁₅ output. Upon completion of the erase operation an attempt to read the device will produce a "1" at the D₇/D₁₅ output.

For Chip Erase, the $\overline{\text{Data}}$ Polling is valid after the rising edge of the sixth $\overline{\text{WE}}$ pulse in the six write pulse sequence. For sector erase, the $\overline{\text{Data}}$ Polling is valid after the last rising edge of the sector erase $\overline{\text{WE}}$ pulse. Even if the device has completed the operation and D₇/D₁₅ has a valid data, the data outputs on D₀ to D₆/D₈ to D₁₄ may be still invalid. The valid data on D₀ to D₇/D₈ to D₁₅ will be read on the successive read attempts.

The $\overline{\text{Data}}$ Polling feature is only active during the programming operation, erase operation, sector erase time-out, Erase Suspend Read mode and Erase Suspend Program mode.

D₆, D₁₄ (Toggle Bit I)

The card also features the "Toggle Bit" as a method to indicate to the host system that the Program/Erase Operation are in progress or completed.

During an Program or Erase cycle, successive attempts to read ($\overline{\text{OE}}$ or $\overline{\text{CE}}$ toggling) data from the card will result in D₆/D₁₄ toggling between one and zero. Once the Program or Erase cycle is completed, D₆/D₁₄ will stop toggling and valid data will be read on the next successive attempts. During programming, the Toggle Bit is valid after the rising edge of the fourth $\overline{\text{WE}}$ pulse in the four write pulse sequence. For chip erase, the Toggle Bit is valid after the rising edge of the sixth $\overline{\text{WE}}$ pulse in the six write pulse sequence. For sector erase, the Toggle Bit is valid after the last rising edge of the sector erase $\overline{\text{WE}}$ pulse. The Toggle Bit is also active during the sector time out.

Either $\overline{\text{CE}}$ or $\overline{\text{OE}}$ toggling will cause the D₆/D₁₄ to toggle.

D₅, D₁₃ (Exceeded Timing Limits)

D₅/D₁₃ will indicate if the program or erase time has exceeded the specified limits (internal pulse count). Under these conditions D₅/D₁₃ will produce a "1". This is a failure condition which indicates that the program or erase cycle was not successfully completed. $\overline{\text{Data}}$ Polling is the only operating function of the card under this condition. If this failure condition occurs during sector erase operation, it specifies that a particular sector is bad and it may not be reused, however, other sectors are still functional and may be used for the program or erase operation. The chip must be reset to use other sectors. Write the Reset command sequence to the chip, and then execute Program or Erase command sequence. This allows the system to continue to use the other active sectors in the chip.

If this failure condition occurs during the chip erase operation, it specifies that the entire chip is bad or combination of sectors are bad.

If this failure condition occurs during the byte programming operation, it specifies that the entire sector containing that byte is bad and this sector may not be reused, (other sectors are still functional and can be reused).

The D₅/D₁₃ failure condition may also appear if a user tries to program a non blank location without erasing. In this case the card locks out and never completes the card operation. Hence, the system never reads a valid data on D₇/D₁₅ bit and D₆/D₁₄ never stops toggling. Once the card has exceeded timing limits, the D₅/D₁₃ bit will indicate a "1". Please note that this is not a device failure condition since the device was incorrectly used.

D₃, D₁₁ (Sector Erase Timer)

After the completion of the initial sector erase command sequence the sector erase time-out will begin. D₃/D₁₁ will remain low until the time-out is complete. $\overline{\text{Data}}$ Polling and Toggle Bit are valid after the initial sector erase command sequence.

If $\overline{\text{Data}}$ Polling or the Toggle Bit indicates the card has been written with a valid erase command, D₃/D₁₁ may be used to determine if the sector erase timer window is still open. If D₃/D₁₁ is high ("1") the internally controlled erase cycle has begun; attempts to write subsequent commands to the card will be ignored until the erase operation is completed as indicated by $\overline{\text{Data}}$ Polling or Toggle Bit. If D₃/D₁₁ is low ("0"), the card will accept additional sector erase commands. To insure the command has been accepted, the system software should check the status of D₃/D₁₁ prior to and following each subsequent sector erase command. If D₃/D₁₁ were high on the second status check, the command may not have been accepted.

Refer to Table : Hardware Sequence Flags.

D₂, D₁₀ (Toggle Bit II, not applied for MB98A81063)

This Toggle bit, along with D₆, can be used to determine whether the card is in the Erase operation or in Erase Suspend.

Successive reads from the erasing sector will cause D₂ to toggle during the Erase operation. If the card is in the erase-suspended-read mode, successive reads from the erase-suspended sector will cause D₂ to toggle. When the card is in the erase-suspended-program mode, successive reads from the byte address of the non-erase suspended sector will indicate a logic '1' at the D₂ bit.

D₆ is different from D₂ in that D₆ toggles only when the standard Program or Erase, or Erase Suspend Program operation is in progress.

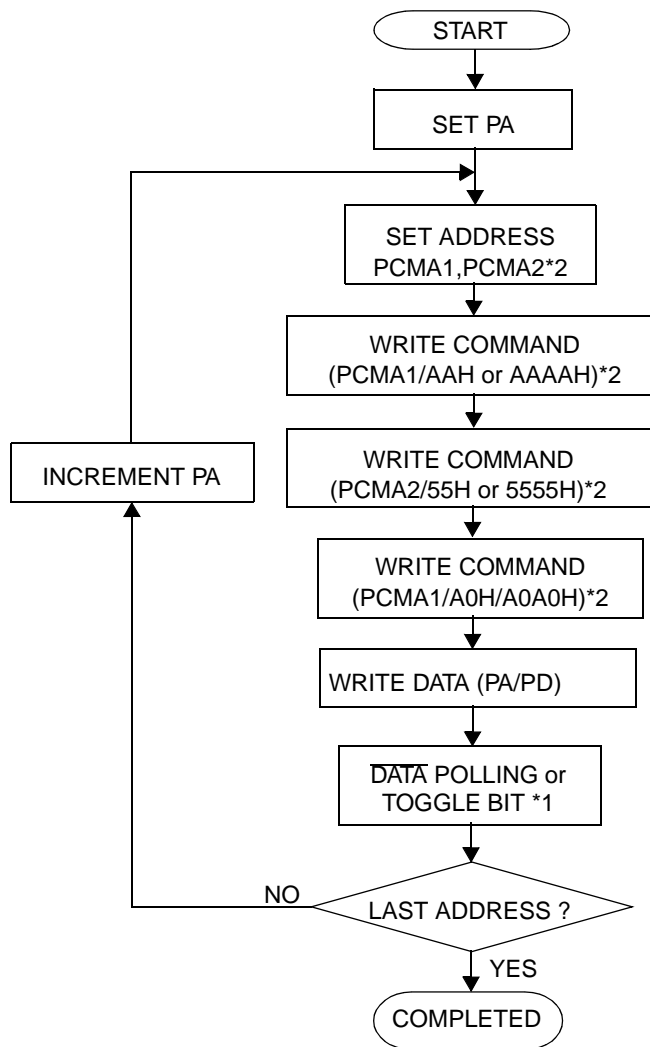
R/ $\overline{\text{B}}$ (Ready/ $\overline{\text{Busy}}$, not applied for MB98A81063)

The card provides a R/ $\overline{\text{B}}$ output pin as a way to indicate to the system that the program or erase operation are either in progress or has been completed. If the output is low, the card is busy with either a program or erase operation. If the card is placed in an Erase Suspend mode, the R/ $\overline{\text{B}}$ output will be high.

During programming, the R/ $\overline{\text{B}}$ pin is driven low after the rising edge of the fourth $\overline{\text{WE}}$ pulse. During an erase operation, the R/ $\overline{\text{B}}$ pin is driven low after the rising edge of the sixth $\overline{\text{WE}}$ pulse. The R/ $\overline{\text{B}}$ pin will indicate a busy condition during the RESET pulse.

PROGRAM / ERASE FLOWCHART

Fig. 3 - PROGRAM FLOWCHART



*1 See Fig. 7, 6, 9, 10.

*2 See "COMMAND DEFINITION TABLE".

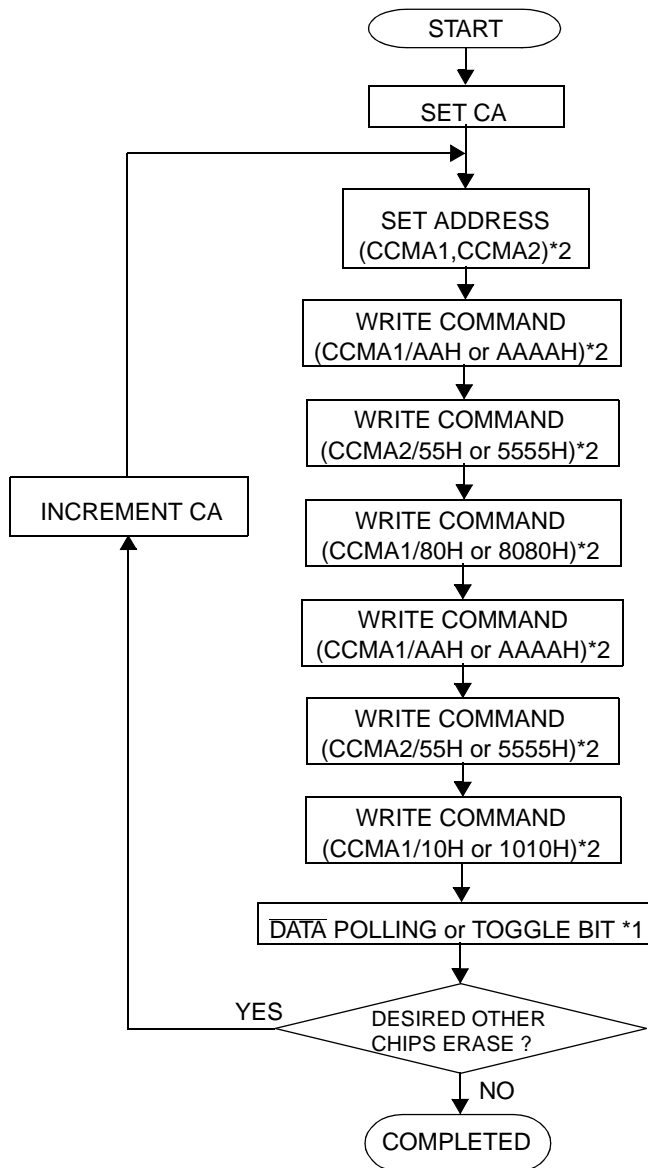
Notes:

PD : PROGRAM DATA

PA : PROGRAM ADDRESS

PROGRAM / ERASE FLOWCHART (Continued)

Fig. 4 - CHIP ERASE FLOWCHART



*1 See Fig. 7, 8, 9, 10.

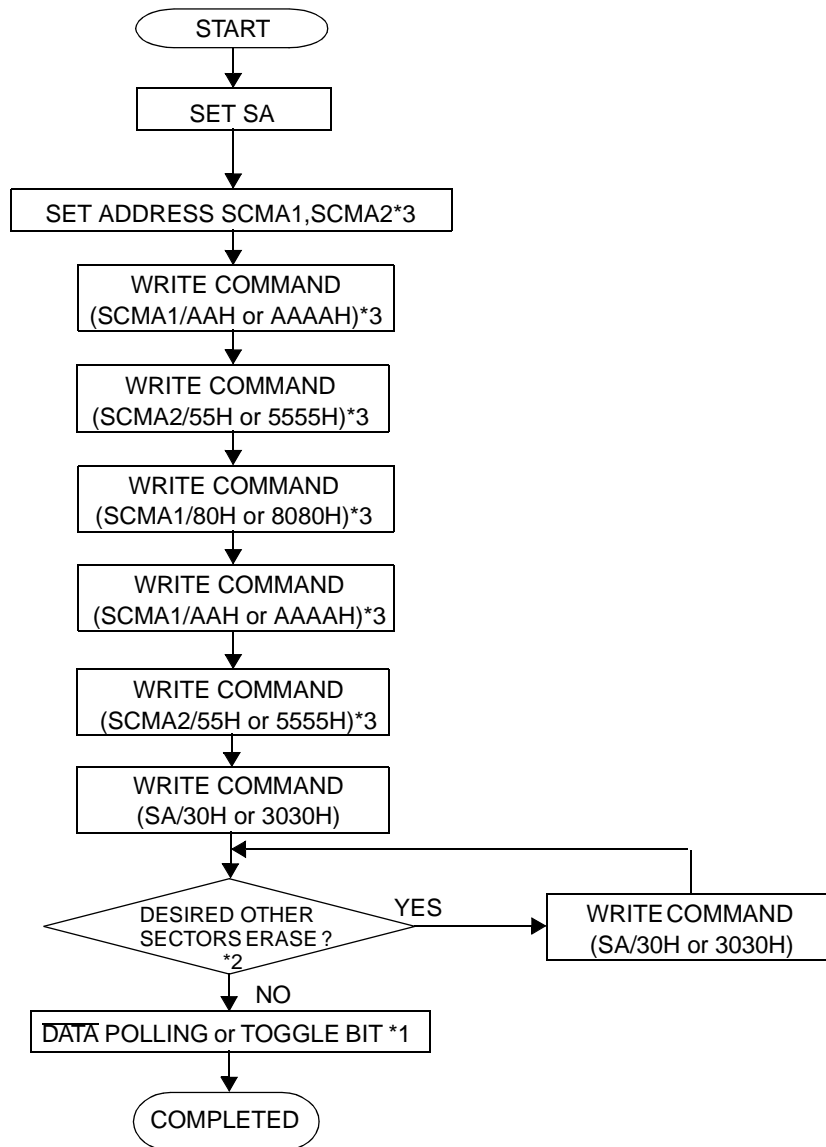
*2 See "COMMAND DEFINITION TABLE".

Note:

CA : CHIP ADDRESS

PROGRAM / ERASE FLOWCHART (Continued)

Fig. 5 - SECTOR ERASE FLOWCHART



*1 See Fig.7, 8, 9, 10.

*2 Possible for the sectors in a chip

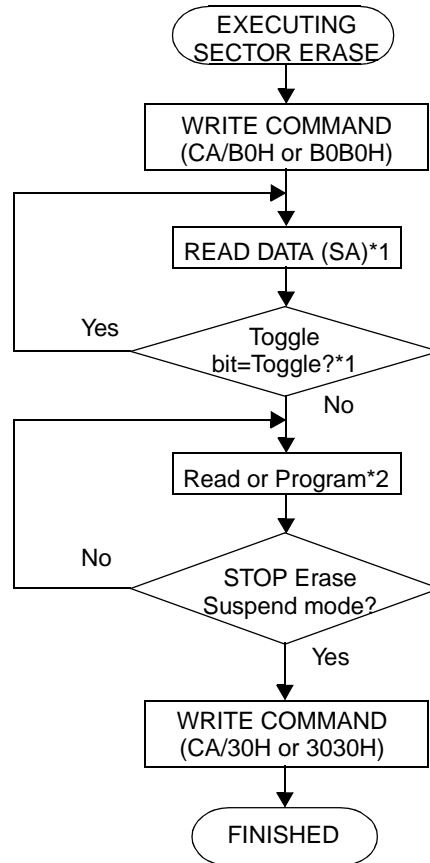
*3 See "COMMAND DEFINITION TABLE".

Note:

SA : SECTOR ADDRESS

PROGRAM / ERASE FLOWCHART (Continued)

Fig. 6 - ERASE SUSPEND FLOWCHART



*1 Detection whether suspend mode is valid can be done by $\overline{\text{Data}}$ Polling and $\text{R}/\overline{\text{B}}$ also. (MB98A81063 does not have $\text{R}/\overline{\text{B}}$).

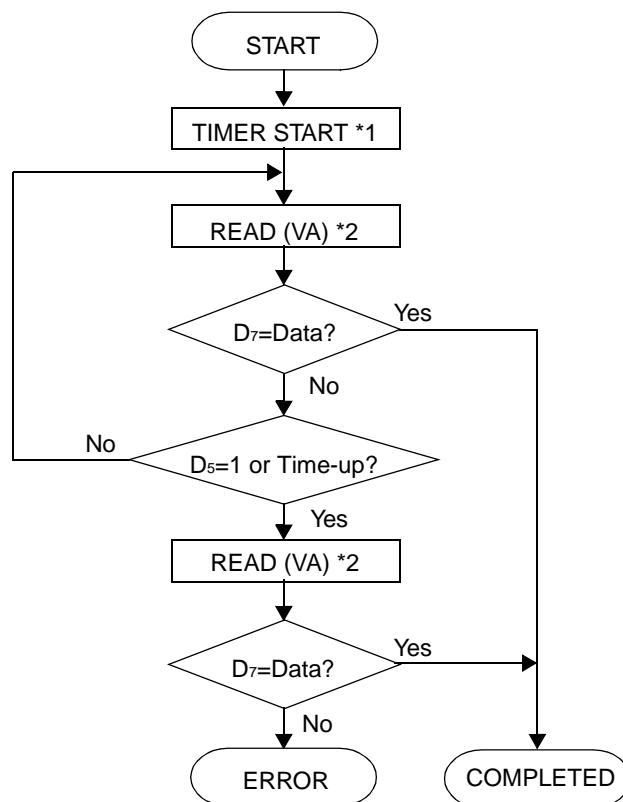
*2 Only Read operation for MB98A81063.

Notes:

CA: CHIP ADDRESS
 SA: SECTOR ADDRESS
 RA: READ ADDRESS

PROGRAM / ERASE FLOWCHART (Continued)

Fig. 7 - DATA POLLING FLOWCHART: × 8-bit mode No.1

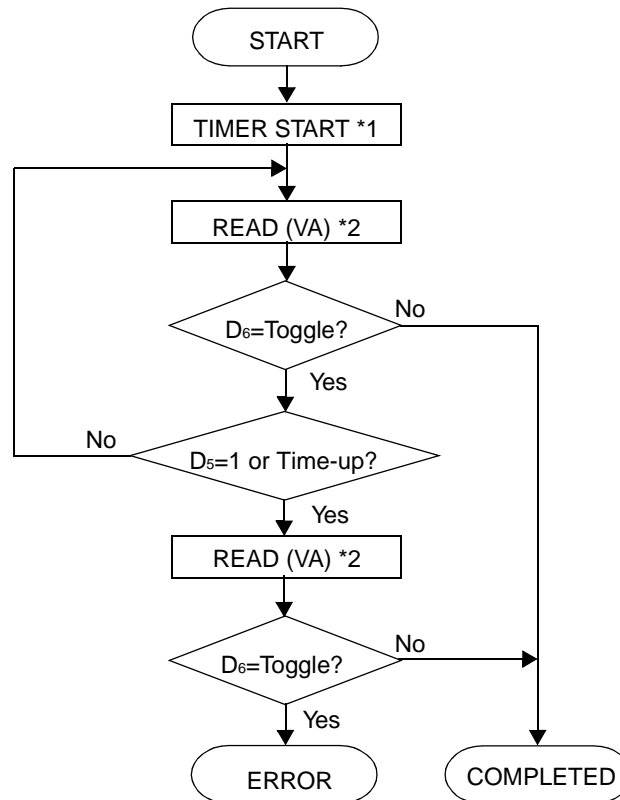


*1 User sets the time period referring to
"PROGRAM AND ERASE PERFORMANCES".

*2 ProgramVA=PA
Chip EraseVA=CA
Sector EraseVA=SA

PROGRAM / ERASE FLOWCHART (Continued)

Fig. 8 - TOGGLE BIT FLOWCHART: × 8-bit mode No.1

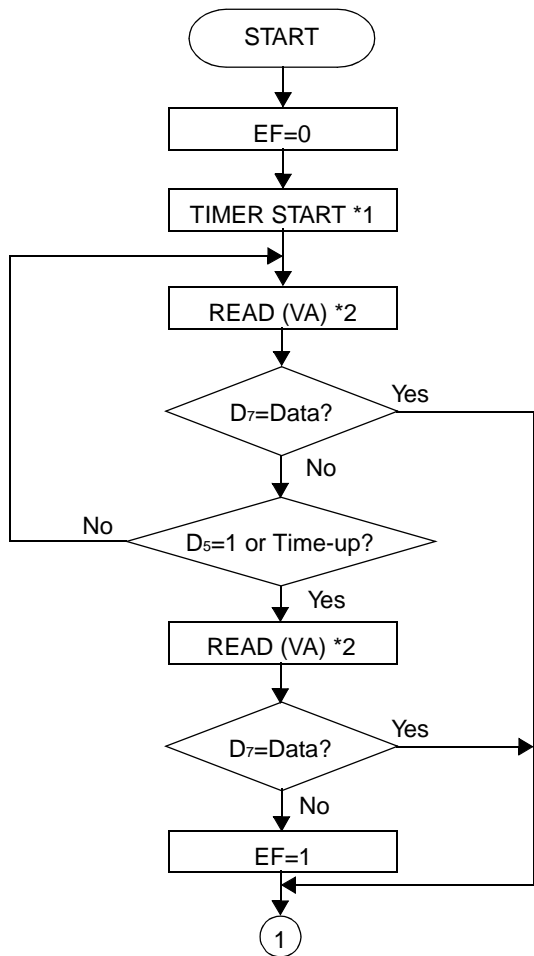


*1 User sets the time period referring to
"PROGRAM AND ERASE PERFORMANCES".

*2 Program VA=PA
Chip Erase VA=CA
Sector EraseVA=SA

PROGRAM / ERASE FLOWCHART (Continued)

Fig. 9 - DATA POLLING FLOWCHART: × 16-bit mode

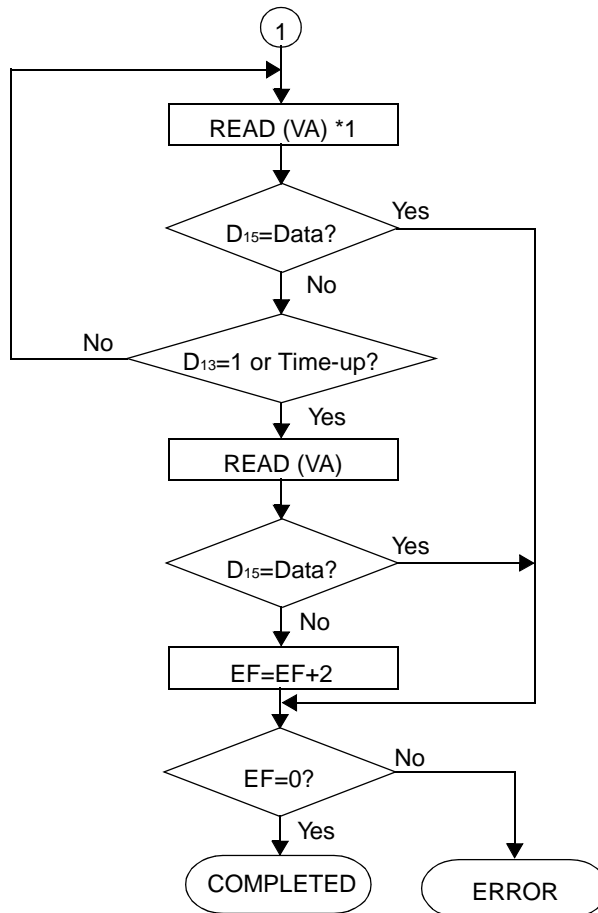


*1 User sets the time period referring to "PROGRAM AND ERASE PERFORMANCES".

*2 Program VA=PA
 Chip Erase VA=CA
 Sector EraseVA=SA

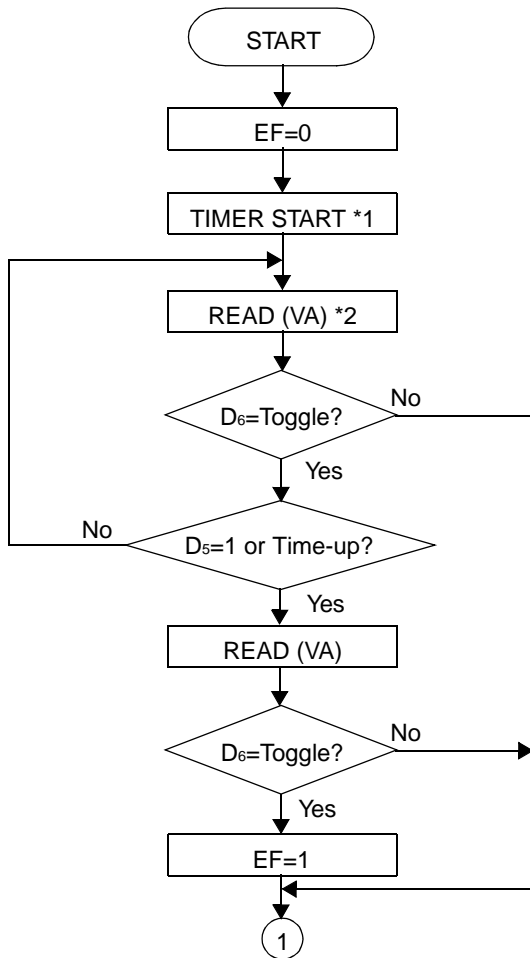
Notes:

- EF: Error Flag
- EF=0: Operation Completed
- EF=1: Lower Byte Error
- EF=2: Upper Byte Error
- EF=3: Lower/Upper Byte Error



PROGRAM / ERASE FLOWCHART (Continued)

Fig. 10 - TOGGLE BIT FLOWCHART: × 16-bit mode

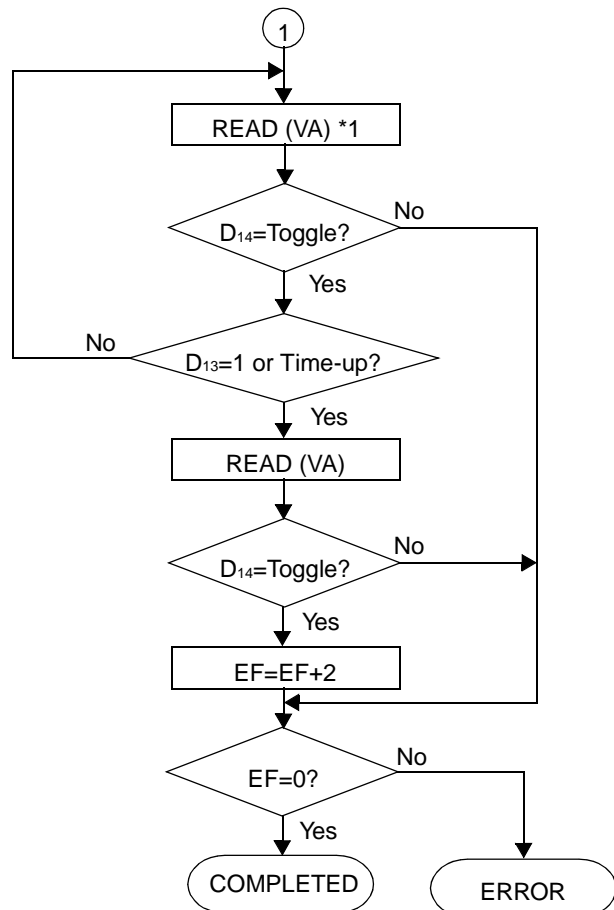


*1 User sets the time period referring to "PROGRAM AND ERASE PERFORMANCES".

*2 Program VA=PA
 Chip Erase VA=CA
 Sector Erase VA=SA

Notes:

- EF: Error Flag
- EF=0: Operation Completed
- EF=1: Lower Byte Error
- EF=2: Upper Byte Error
- EF=3: Lower/Upper Byte Error



■ ABSOLUTE MAXIMUM RATINGS (See WARNING)

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	-0.5 to +6.0	V
Input Voltage	V_{IN}	-0.5 to $V_{CC} + 0.5$	V
Output Voltage	V_{OUT}	-0.5 to $V_{CC} + 0.5$	V
Temperature under Bias	T_A	0 to +60	°C
Storage Temperature	T_{STG}	-30 to +70	°C

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

(Referenced to V_{SS})

Parameter	Symbol	Min.	Typ.	Max.	Unit
V_{CC} Supply Voltage	V_{CC}	4.75	5.0	5.25	V
Ground	GND		0		V
Ambient Temperature	T_A	0		55	°C

WARNING: Recommended operating conditions are normal operating ranges for the semiconductor device. All the device's electrical characteristics are warranted when operated within these ranges.

Always use semiconductor devices within the recommended operating conditions. 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 representative beforehand.

■ CAPACITANCE

($T_A = 25^\circ\text{C}$, $f = 1\text{ MHz}$, $V_{IN} = V_{I/O} = \text{GND}$)

Parameter	Symbol	Min.	Max.	Unit
Input Capacitance *1	C_{IN}		75	pF
I/O Capacitance *2	$C_{I/O}$		50	pF

Notes:

*1 This value does not apply to $\overline{CE1}$, $\overline{CE2}$, \overline{WE} , \overline{REG} and RESET.

*2 This value does not apply to $\overline{CD1}$, $\overline{CD2}$, BVD1 and BVD2.

■ DC CHARACTERISTICS

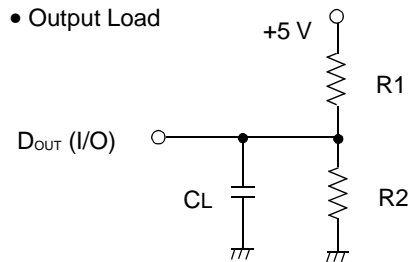
Parameter	Test Conditions	Symbol	Value			Unit
			Min.	Typ.	Max.	
Input Leakage Current *1	$V_{CC} = V_{CC \text{ max.}}, V_{IN} = 0 \text{ V or } V_{CC}$	I_{LI}		± 1.0	± 20	μA
Output Leakage Current *2	$V_{CC} = V_{CC \text{ max.}}, V_{IN} = 0 \text{ V or } V_{CC}$	I_{LO}		± 1.0	± 20	μA
Standby Current	$V_{CC} = V_{CC \text{ max.}}$ $\overline{CE1}, \overline{CE2} = V_{CC}, V_{IN} = 0 \text{ V or } V_{CC}$	I_{SB1}		0.5^{*4}	1.7^{*4}	mA
			0.6^{*5}	3.0^{*5}		
	$V_{CC} = V_{CC \text{ max.}}, \overline{CE1}, \overline{CE2} = V_{IH}$ $V_{IN} = V_{IL} \text{ or } V_{IH}$	I_{SB2}		4.0	8.0	mA
Active Read Current	$V_{CC} = V_{CC \text{ max.}}, \overline{CE1}, \overline{CE2} = V_{IL}$ Cycle = 200 ns, $I_{OUT} = 0 \text{ mA}$	I_{CC1}		100^{*4}	160^{*4}	mA
				150^{*5}	200^{*5}	
Program Current	Program in progress ($\times 16$ mode)	I_{CC2}			120	mA
Erase Current	Erase in progress ($\times 16$ mode)	I_{CC3}			120	mA
Input Low Voltage	—	V_{IL}	-0.3	—	0.8	V
Input High Voltage	—	V_{IH}	2.4	—	$V_{CC} + 0.3$	V
Output Low Voltage	$I_{OL} = 3.2 \text{ mA}, V_{CC} = V_{CC \text{ min.}}$	V_{OL}			0.4	V
Output High Voltage *3	$I_{OH} = 2.0 \text{ mA}, V_{CC} = V_{CC \text{ min.}}$	V_{OH}	3.8			V
Low V_{CC} Lock-out Voltage	Common Memory Attribute Memory	V_{LKO}	3.2	3.7	4.2	V
			—	3.8	—	V

Notes:

- *1 This value does not apply to $\overline{CE1}$, $\overline{CE2}$, \overline{WE} and \overline{REG} .
- *2 This value does not apply to $\overline{BVD1}$, $\overline{BVD2}$, $\overline{CD1}$ and $\overline{CD2}$.
- *3 This value does not apply to $\overline{BVD1}$ and $\overline{BVD2}$.
- *4 MB98A81063/81183/81273/81373/81473/81573
- *5 MB98A81674

■ AC TEST CONDITIONS

Fig. 11 - AC TEST CONDITIONS



- Input Pulse Levels: $V_{IH} = 2.6\text{ V}$, $V_{IL} = 0.6\text{ V}$

- Input Pulse Rise and Fall Times: 5 ns
(Transient between 0.8 V and 2.4 V)

- Timing Reference Levels

Input: $V_{IL} = 0.8\text{ V}$, $V_{IH} = 2.4\text{ V}$

Output: $V_{OL} = 0.8\text{ V}$, $V_{OH} = 2.0\text{ V}$

* Including jig and stray capacitance

	R1	R2	CL	Parameter Measured
Load I	1.8 K Ω	990 Ω	100 pF	All parameters except tCLZ, tOLZ, tCHZ, tOHZ, tRCLZ, tROLZ, tRCHZ and tROHZ
Load II	1.8 K Ω	990 Ω	5 pF	tCLZ, tOLZ, tCHZ, tOHZ, tRCLZ, tROLZ, tRCHZ and tROHZ

■ PROGRAM AND ERASE PERFORMANCES

MAIN MEMORY PROGRAM / ERASE PERFORMANCE

(MB98A81063)

Parameter	Min.	Typ.	Max.	Unit
Byte Program Time *1		8	500	μs
Chip Programming Time *1		4.2	25	Sec.
Sector Erase Time *2		1	15	Sec.
Program/Erase Cycles	100,000			Cycles

Notes:

*1 Excludes system-level overhead.

*2 Excludes 00H programming prior to erasure.

(MB98A81183)

Parameter	Min.	Typ.	Max.	Unit
Byte Program Time *1		8	500	μs
Chip Programming Time *1		8.4	50	Sec.
Sector Erase Time *2		1	15	Sec.
Program/Erase Cycles	100,000			Cycles

Notes:

*1 Excludes system-level overhead.

*2 Excludes 00H programming prior to erasure.

MB98A81063-15/81183-15/81273-15/81373-15/81473-15/81573-15/81674-20

PROGRAM AND ERASE PERFORMANCES (Continued)

(MB98A81273, 81373, 81473, 81573, 81674)

Parameter	Min.	Typ.	Max.	Unit
Byte Programming Time *1		8	500	μs
Chip Programming Time *1		16.8	100	Sec.
Sector Erase Time *2		1	15	Sec.
Program/Erase Cycles	100,000			Cycles

Notes:

*1 Excludes system-level overhead.

*2 Excludes 00H programming prior to erasure.

ATTRIBUTE MEMORY PROGRAM PERFORMANCE

Parameter	Min.	Typ.	Max.	Unit
Byte Program Time			1	ms
Number of Program per Byte	100,000			Times

AC CHARACTERISTICS

(Recommended operating conditions unless otherwise noted.)

MAIN MEMORY READ CYCLE*1

Parameter	Symbol	Min.	Max.	Unit
Read Cycle Time	tRC	150 (200)		ns
Card Enable Access Time	tCE		150 (200)	ns
Address Access Time	tACC		150 (200)	ns
Output Enable Access Time	tOE		75 (100)	ns
Card Enable to Output in Low-Z*2	tCLZ	5		ns
Card Disable to Output in High-Z*2	tCHZ		60	ns
Output Enable to Output in Low-Z*2	tOLZ	5		ns
Output Disable to Output in High-Z*2	tOHZ		60	ns
Output Hold from Address, \overline{CE} , or \overline{OE} Change *3	tOH	5		ns
Ready Time from RESET	tRDY		20	ms

Notes:

*1 Rise/Fall time < 5 ns.

*2 Transition is measured at the point of ± 500 mV from steady state voltage. This parameter is specified using Load II in Fig. 11.

*3 This parameter is specified from the rising edge of \overline{OE} , $\overline{CE1}$ or $\overline{CE2}$, whichever occurs first. Values of () are for MB98A81674.

■ AC CHARACTERISTICS (Continued)

(Recommended operating conditions unless otherwise noted.)

MAIN MEMORY PROGRAM / ERASE CYCLE*1 *2

Parameter	Symbol	Min.	Typ.	Max.	Unit
Write Cycle Time	tWC	150			ns
Address Setup Time	tAS	20			ns
Address Hold Time	tAH	20			ns
Data Setup Time	tDS	50			ns
Data Hold Time	tDH	20			ns
Read Recovery Time (\overline{WE} control)	tGHWL	10			ns
Read Recovery Time (\overline{CE} control)	tGHEL	10			ns
Output Enable Hold Time	tOEHL	10			ns
Card Enable Setup Time	tCS	20			ns
Card Enable Hold Time	tCH	0			ns
Write Enable Pulse Width	tWP	80			ns
Write Enable Setup Time	tWS	0			ns
Write Enable Hold Time	tWH	0			ns
Card Enable Pulse Width	tCP	100			ns
Duration of Byte Program Operation (\overline{WE} control)	tWHWH1		8		μ s
Duration of Erase Operation *3 (\overline{WE} control)	tWHWH2		1	15	s
Duration of Byte Program Operation (\overline{CE} control)	tEHEH1		8		μ s
Duration of Erase Operation *3 (\overline{CE} control)	tEHEH2		1	15	s
V _{CC} Setup Time *4	tVCS	50			μ s
Reset Pulse Width	tRP	500			ns
Busy Delay Time	tBSY	100			ns

Notes:

- *1 Read timing parameters during Program/Erase operations are the same as those during read only operations. Refer to AC characteristics for Main Memory Read Cycle.
- *2 Rise/Fall time \leq 5 ns.
- *3 These do not include the preprogramming time.
- *4 Not 100% tested.
Values of () are for MB98A81674.

■ AC CHARACTERISTICS (Continued)

ATTRIBUTE MEMORY READ CYCLE *1

Parameter	Symbol	Min.	Max.	Unit
Read Cycle Time	tRRC	250		ns
Address Access Time	tRAA		250	ns
Card Enable Access Time	tRCE		250	ns
Output Enable Access Time	tROE		125	ns
Output Hold from Address Change	tROH	5		ns
Card Enable to Output Low-Z *2	tRCLZ	5		ns
Output Enable to Output Low-Z *2	tROLZ	5		ns
Card Enable to Output High-Z *2	tRCHZ		60	ns
Output Enable to Output High-Z *2*3	tROHZ		60	ns

Notes:

*1 Rise/Fall time < 5 ns.

*2 Transition is measured at the point of ± 500 mV from steady state voltage. This parameter is specified using Load II in Fig. 3.

*3 This parameter is specified from the rising edge of \overline{OE} , $\overline{CE1}$ or $\overline{CE2}$, whichever occurs first.

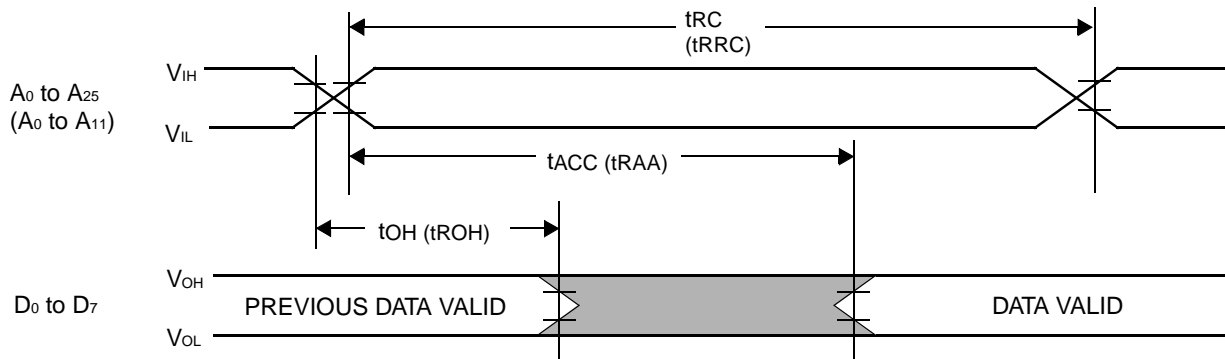
ATTRIBUTE MEMORY PROGRAM CYCLE

Parameter	Symbol	Min.	Max.	Unit
Address Setup Time	tRAS	20		ns
Card Enable Setup Time	tRCS	0		ns
Output Enable Setup Time	tOES	20		ns
Write Pulse Width	tRWP	100	1000	ns
Address Hold Time	tRAH	50		ns
Data Setup Time	tRDS	50		ns
Data Hold Time	tRDH	20		ns
Card Enable Hold Time	tRCH	0		ns
Output Enable Hold Time	tROEH	20		ns
Program Time	tRWR		1	ms

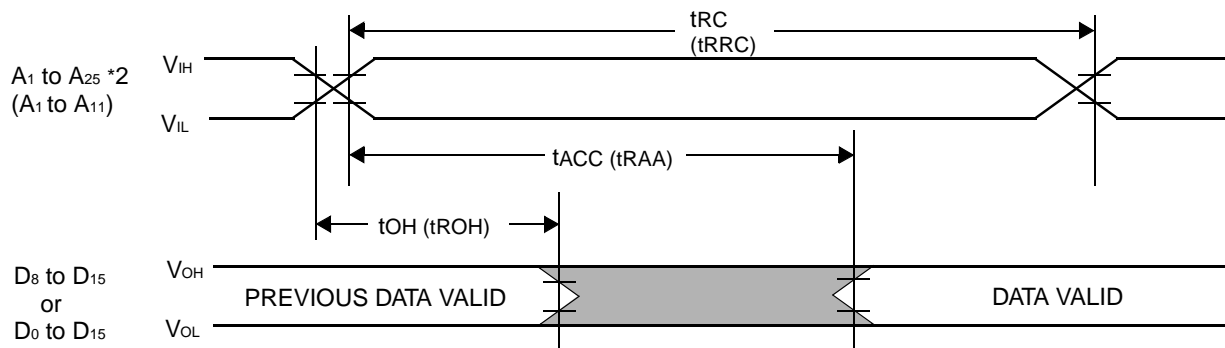
■ TIMING DIAGRAM


MAIN / ATTRIBUTE MEMORY READ CYCLE TIMING DIAGRAM ($\overline{WE} = V_{IH}$, $\overline{REG} = V_{IH}$)*1

READ CYCLE 1: $\overline{CE1} = \overline{OE} = V_{IL}$, $\overline{CE2} = V_{IH}$: × 8-bit No.1 Bus Organization



READ CYCLE 2: $\overline{CE1} = V_{IH}$, $\overline{CE2} = \overline{OE} = V_{IL}$: × 8-bit No.2 Bus Organization
 $\overline{CE1} = \overline{CE2} = \overline{OE} = V_{IL}$: × 16-bit Bus Organization



 :Undefined

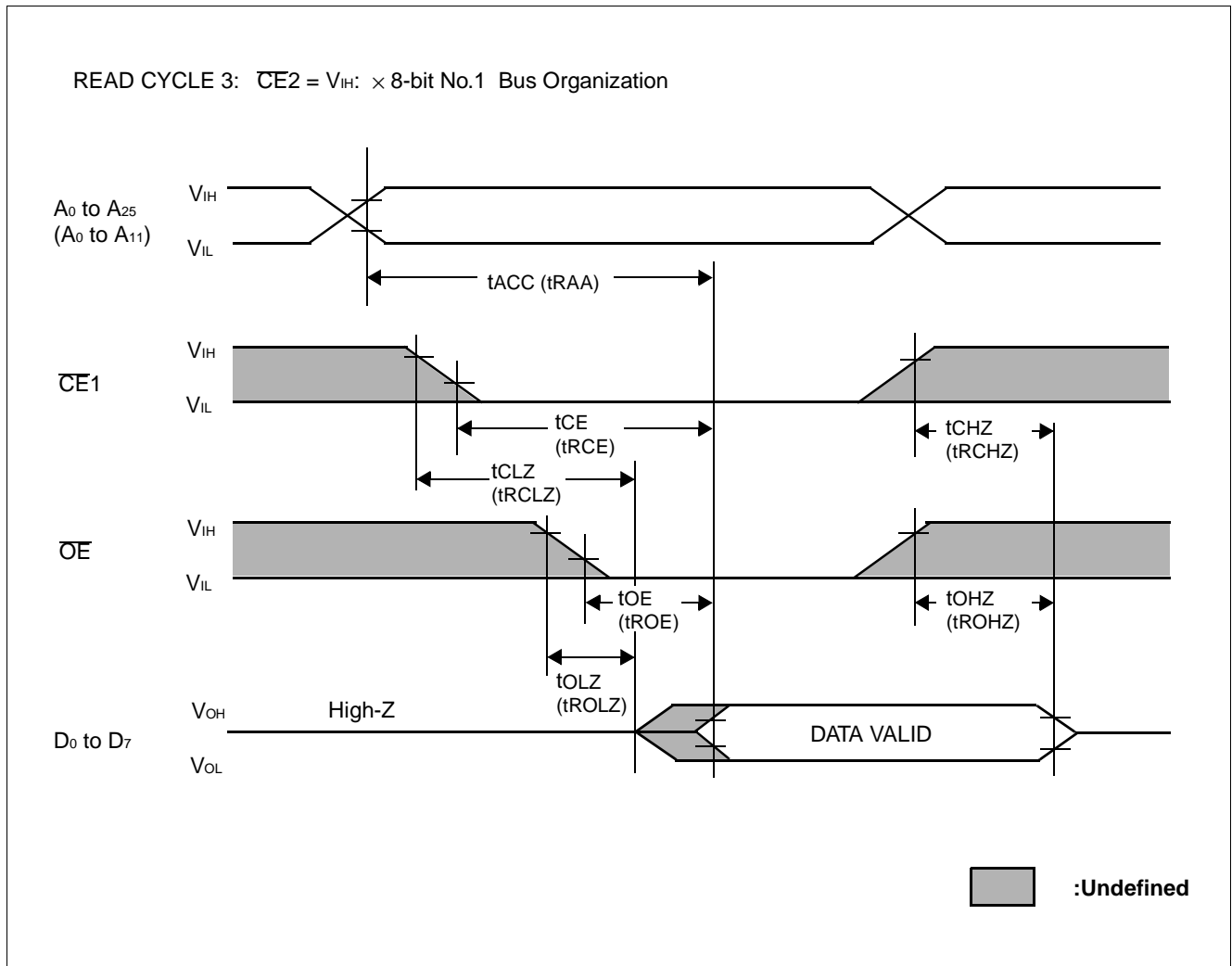
Notes:

*1 The addresses and parameters in () are applied for attribute memory access.

*2 A₀ = Either V_{IH} or V_{IL}.

■ TIMING DIAGRAM (Continued)

MAIN / ATTRIBUTE MEMORY READ CYCLE TIMING DIAGRAM (Continued) ($\overline{WE} = V_{IH}$, $\overline{REG} = V_{IH}$)*1



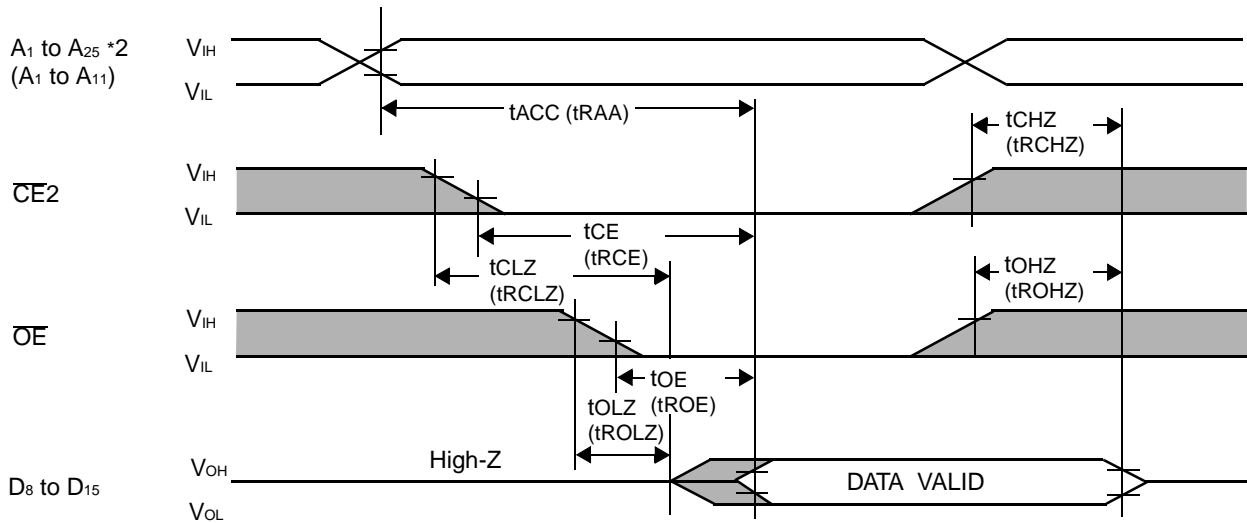
Note:

*1 The addresses and parameters in () are applied for attribute memory access.

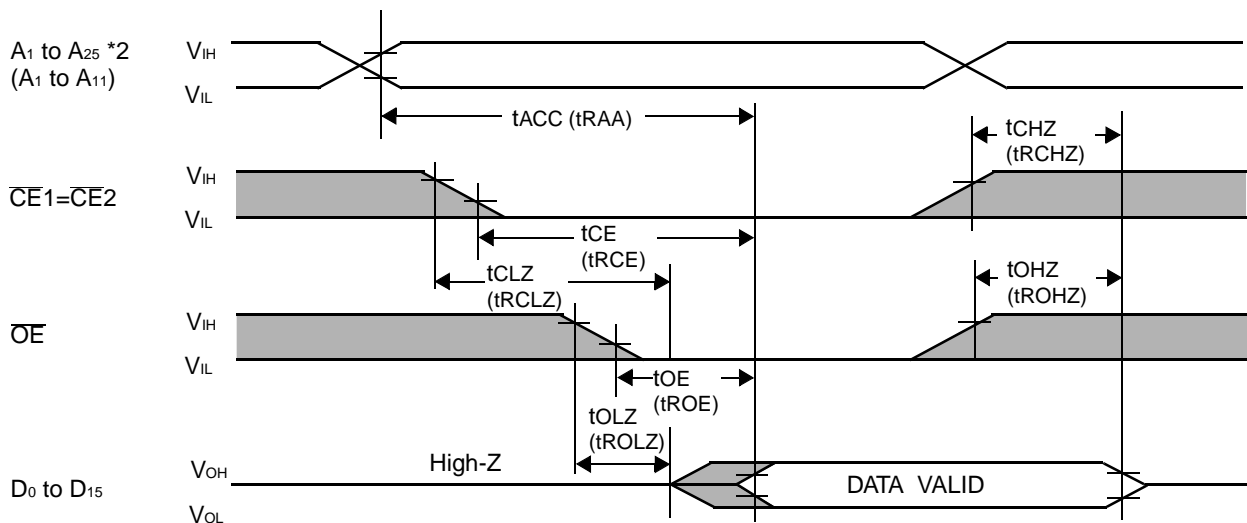
■ TIMING DIAGRAM (Continued)

MAIN / ATTRIBUTE MEMORY READ CYCLE TIMING DIAGRAM(Continued)($\overline{WE} = V_{IH}$, $\overline{REG} = V_{IH}$)*1

READ CYCLE 4: $\overline{CE1} = V_{IH}$: × 8-bit No.2 Bus Organization



READ CYCLE 5: $\overline{CE1} = \overline{CE2} = V_{IL}$: × 16-bit Bus Organization



■ :Undefined

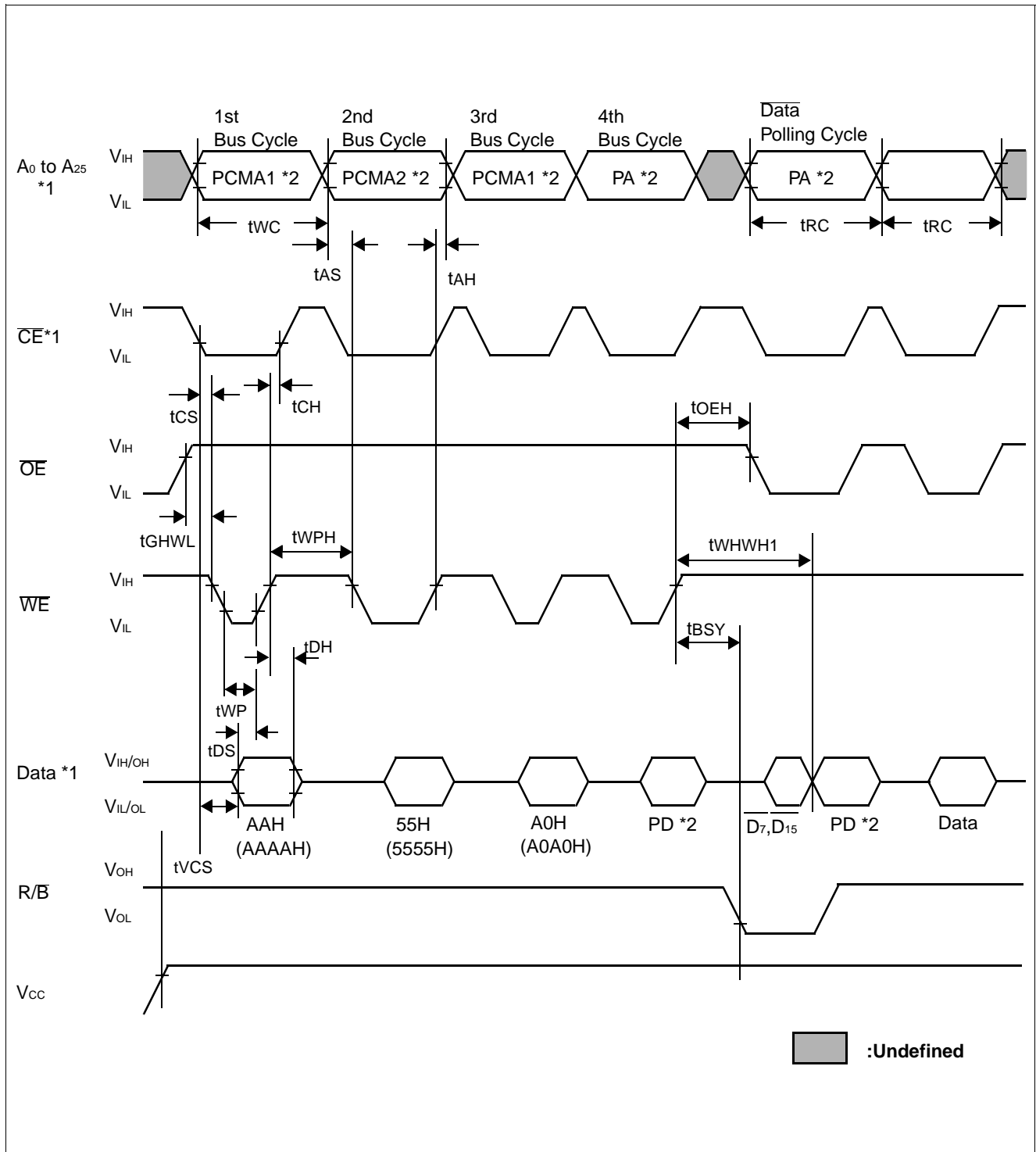
Notes:

*1 The addresses and parameters in () are applied for attribute memory access.

*2 $A_0 =$ Either V_{IH} or V_{IL} .

■ TIMING DIAGRAM (Continued)

MAIN MEMORY PROGRAM CYCLE TIMING DIAGRAM (\overline{WE} = CONTROLLED, $\overline{REG} = V_{IH}$)



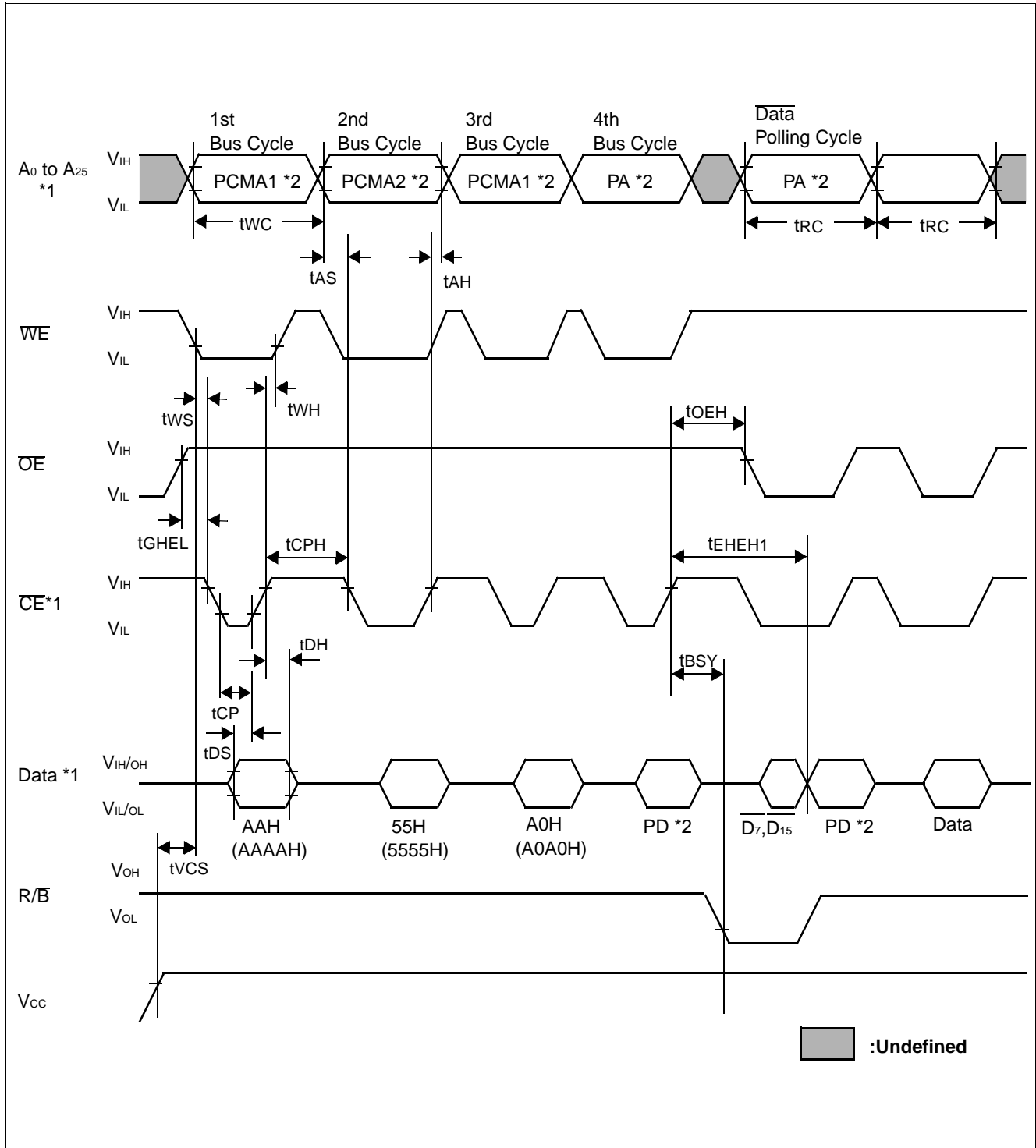
Notes:

*1 See "FUNCTION TRUTH TABLE".

*2 PCMA1/PCMA2 = Command Address for Program, PA = Program Address, PD = Program Data. See "COMMAND DEFINITION TABLE".

■ TIMING DIAGRAM (Continued)

MAIN MEMORY PROGRAM CYCLE TIMING DIAGRAM (\overline{CE} = CONTROLLED, $\overline{REG} = V_{IH}$)



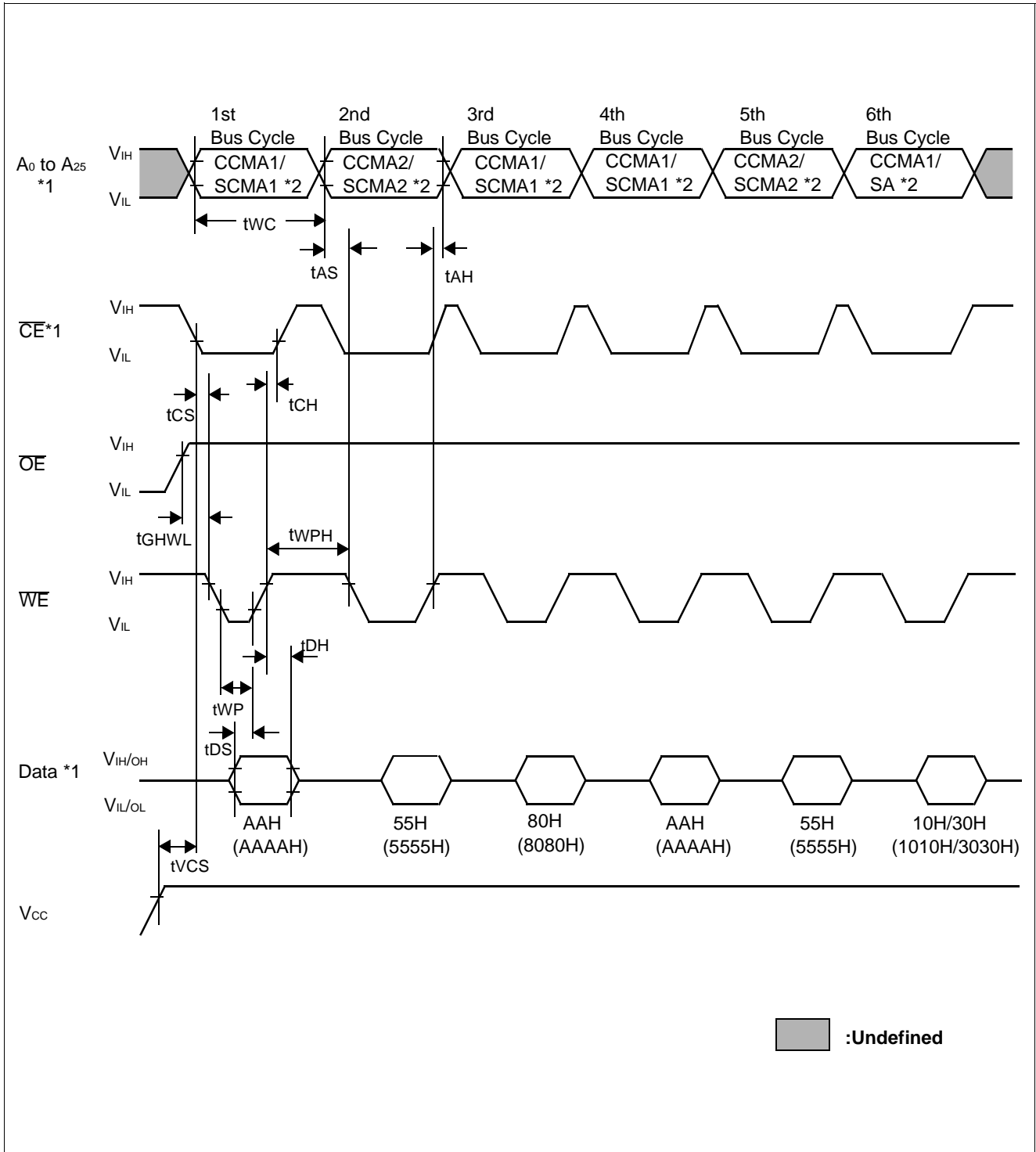
Notes:

*1 See "FUNCTION TRUTH TABLE".

*2 PCMA1/PCMA2 = Command Address for Program, PA = Program Address, PD = Program Data. See "COMMAND DEFINITION TABLE".

■ TIMING DIAGRAM (Continued)

MAIN MEMORY ERASE CYCLE TIMING DIAGRAM (\overline{WE} = CONTROLLED, $\overline{REG} = V_{IH}$)



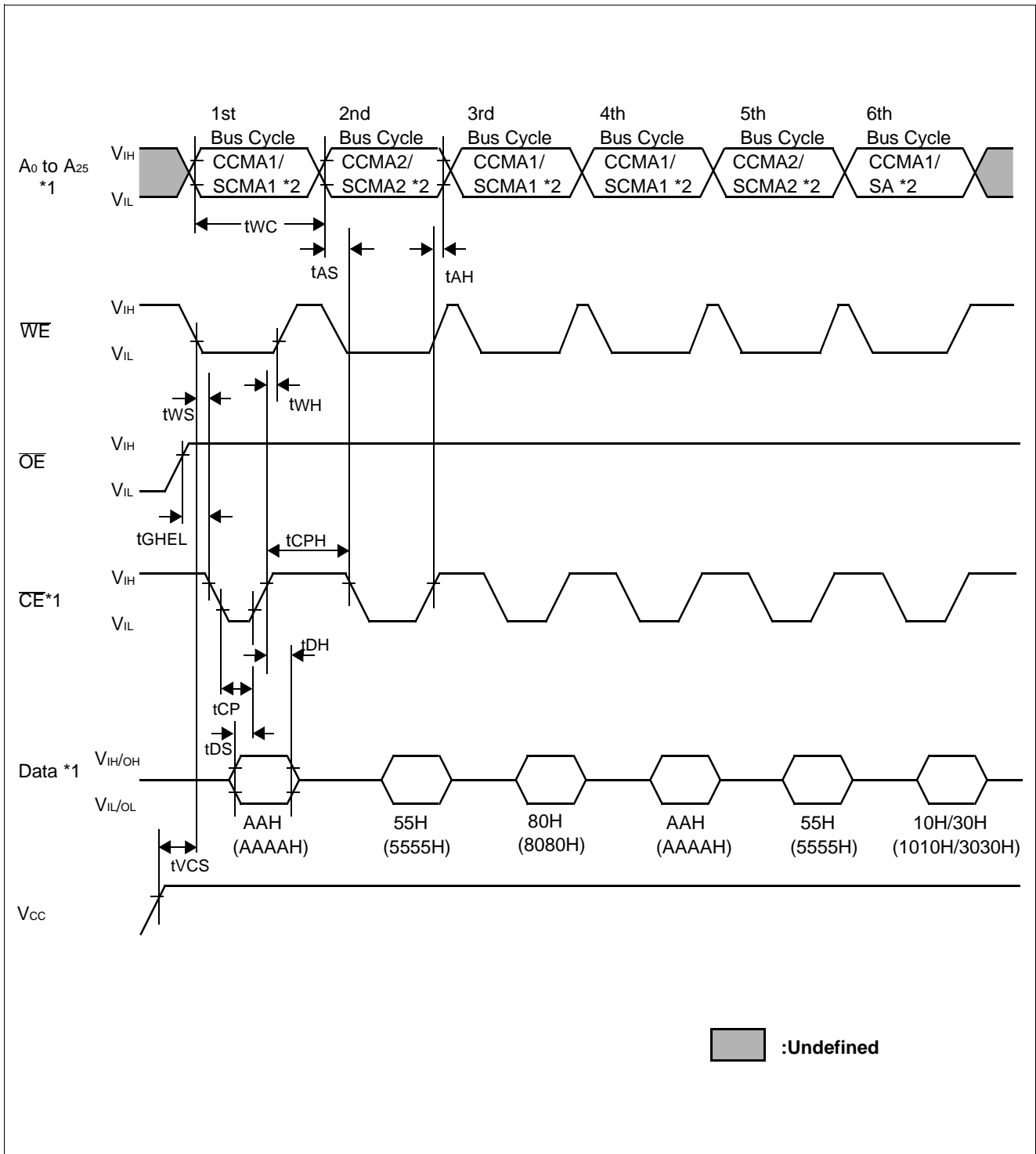
Notes:

*1 See "FUNCTION TRUTH TABLE".

*2 CCMA1/CCMA2 = Command Address for Chip Erase, SCMA1/SCMA2 = Command Address for Sector Erase, SA = Sector Address. See "COMMAND DEFINITION TABLE".

■ TIMING DIAGRAM (Continued)

MAIN MEMORY ERASE CYCLE TIMING DIAGRAM (\overline{CE} = CONTROLLED, $\overline{REG} = V_{IH}$)



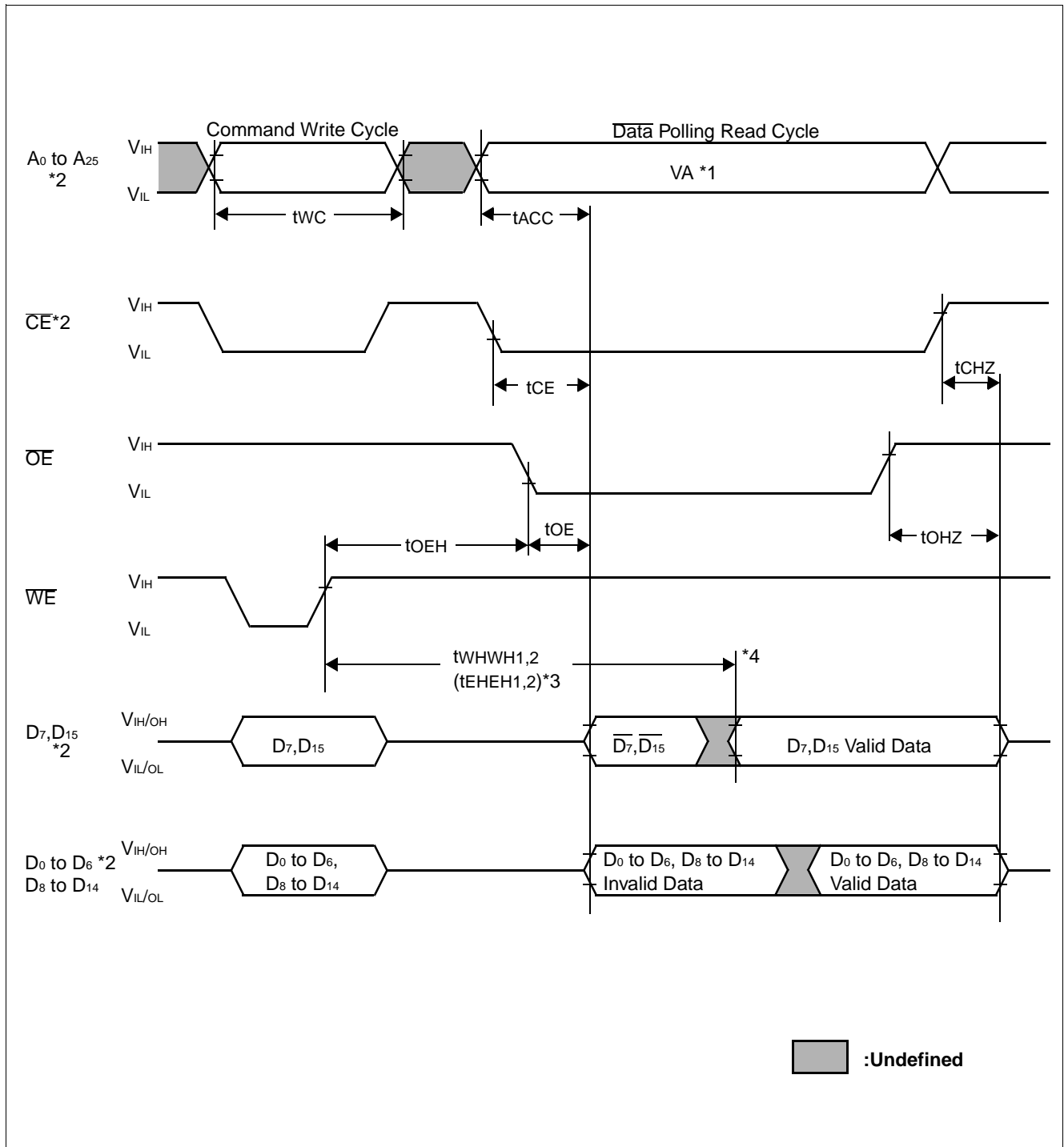
Notes:

*1 See "FUNCTION TRUTH TABLE".

*2 CCMA1/CCMA2 = Command Address for Chip Erase, SCMA1/SCMA2 = Command Address for Sector Erase, SA = Sector Address. See "COMMAND DEFINITION TABLE".

■ TIMING DIAGRAM (Continued)

MAIN MEMORY DATA POLLING CYCLE TIMING DIAGRAM ($\overline{REG} = V_{IH}$)



Notes:

*1 VA = PA for Programming Cycle, VA = SA for Sector Erase, VA = CA for Chip Erase.

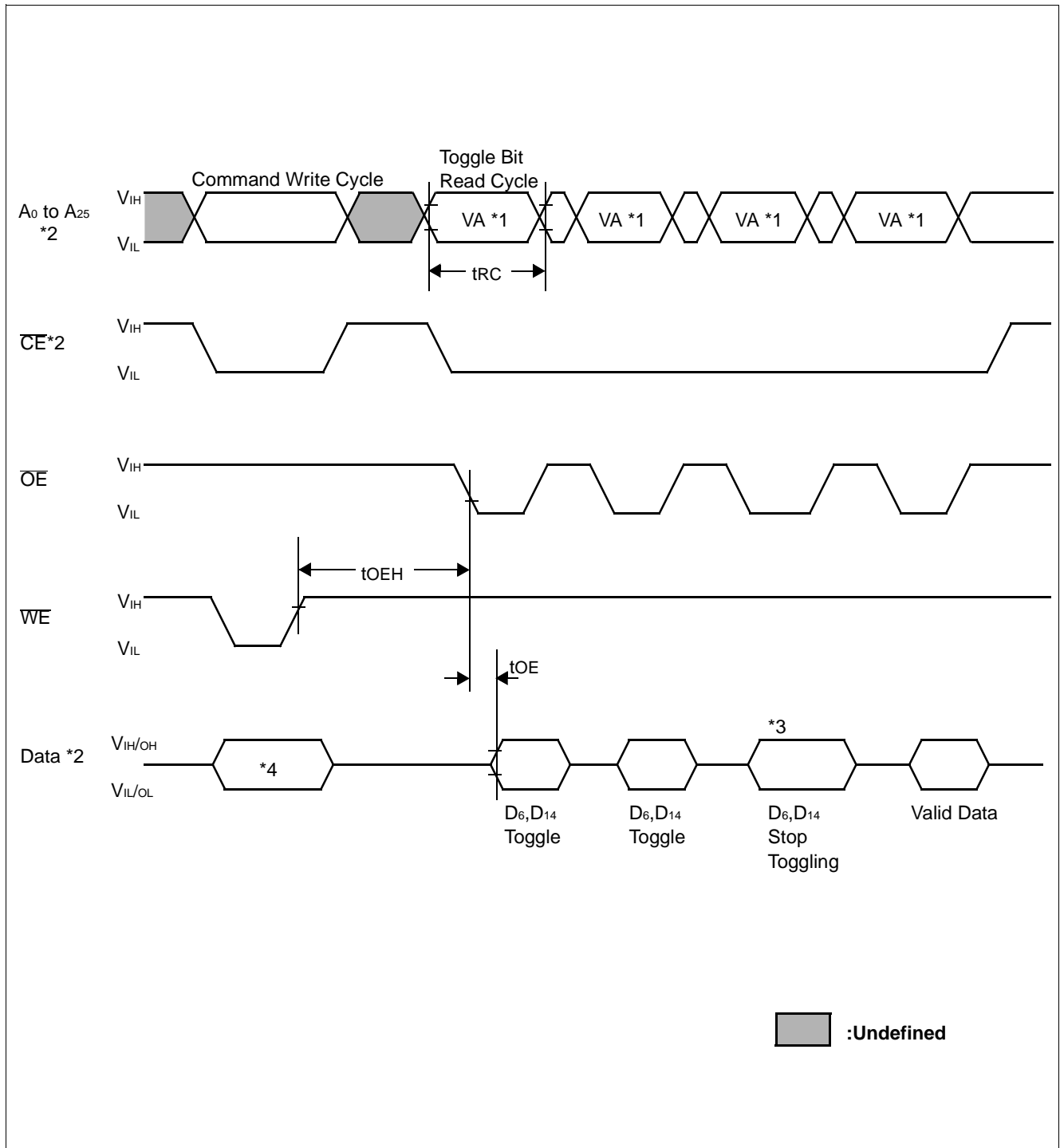
*2 See "FUNCTION TRUTH TABLE".

*3 $t_{EHEH1, 2}$ for \overline{CE} Control.

*4 Program/Erase operation is finished.

■ TIMING DIAGRAM (Continued)

MAIN MEMORY TOGGLE BIT TIMING DIAGRAM ($\overline{REG} = V_{IH}$)



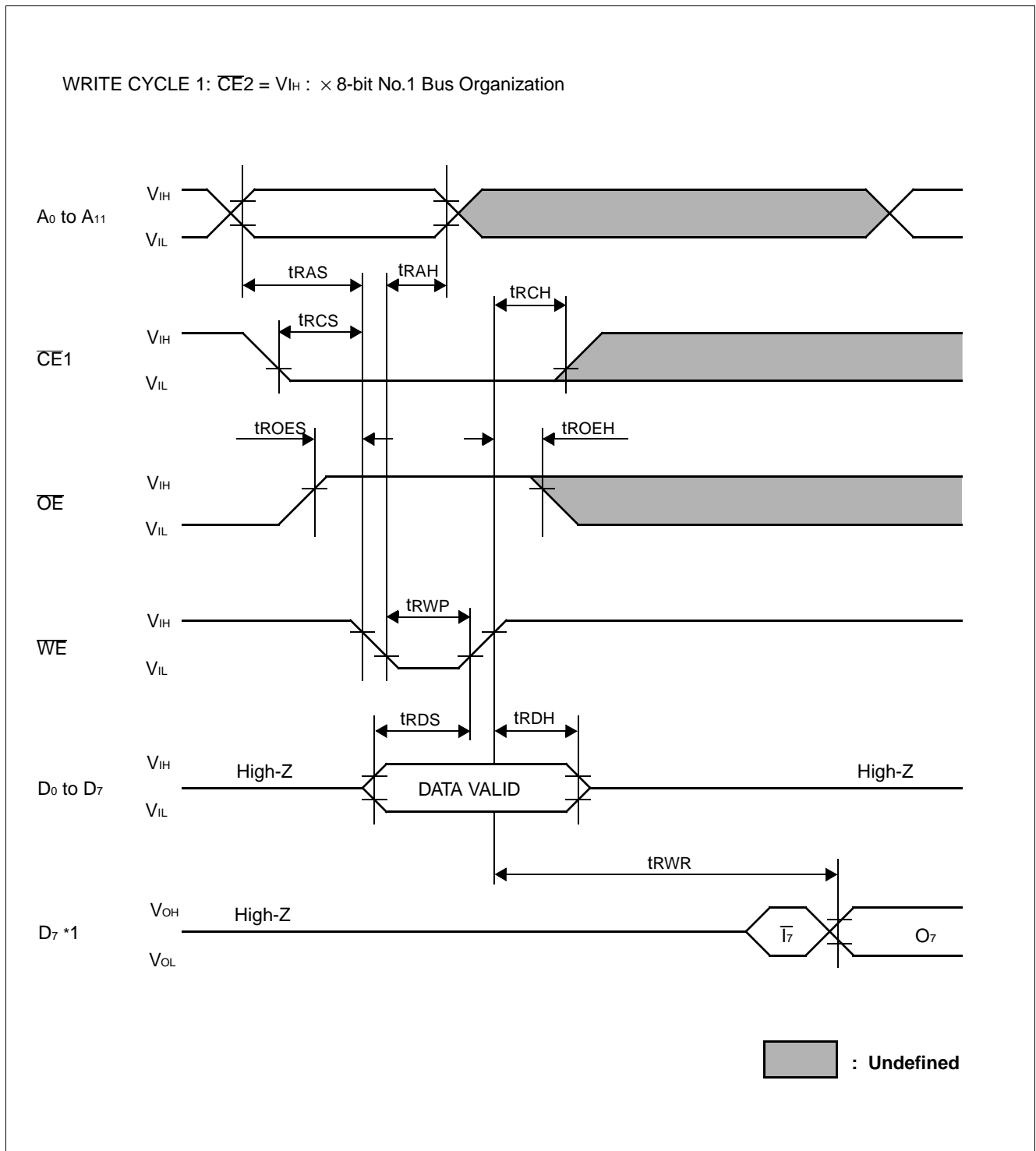
Notes:

- *1 $VA = PA$ for Programming Cycle, $VA = SA$ for Sector Erase, $VA = CA$ for Chip Erase.
- *2 See "FUNCTION TRUTH TABLE".
- *3 Program/Erase operation is finished.
- *4 PD, 10H (1010H) or 30H (3030H)

■ AC CHARACTERISTICS (Continued)

(Recommended operating conditions unless otherwise noted.)

ATTRIBUTE MEMORY WRITE CYCLE TIMING DIAGRAM (\overline{WE} = CONTROLLED, \overline{REG} = V_{IL})



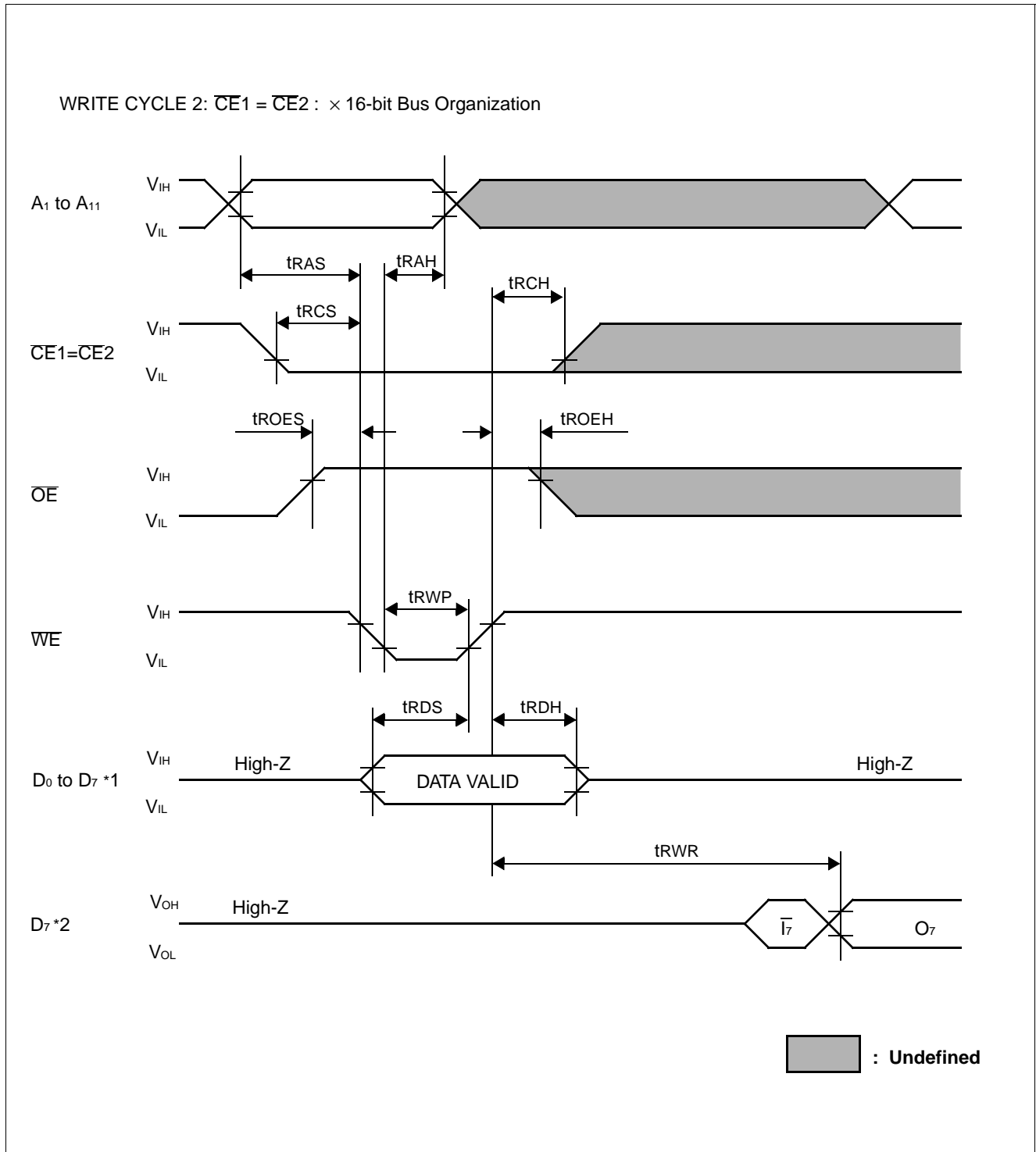
Note:

*1 Data polling operation.

■ AC CHARACTERISTICS (Continued)

(Recommended operating conditions unless otherwise noted.)

ATTRIBUTE MEMORY WRITE CYCLE TIMING DIAGRAM (\overline{WE} = CONTROLLED, $\overline{REG} = V_{IL}$)



Notes:

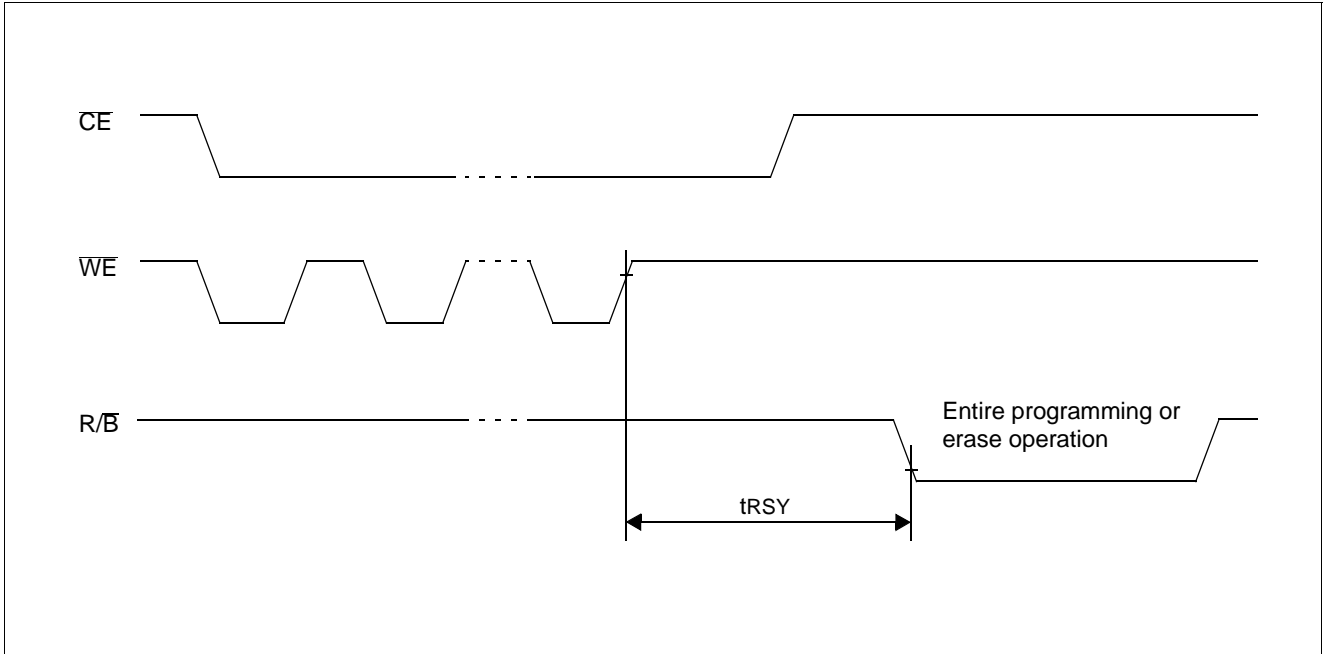
*1 Inputs from D₈ to D₁₅ are not defined.

*2 Data polling operation.

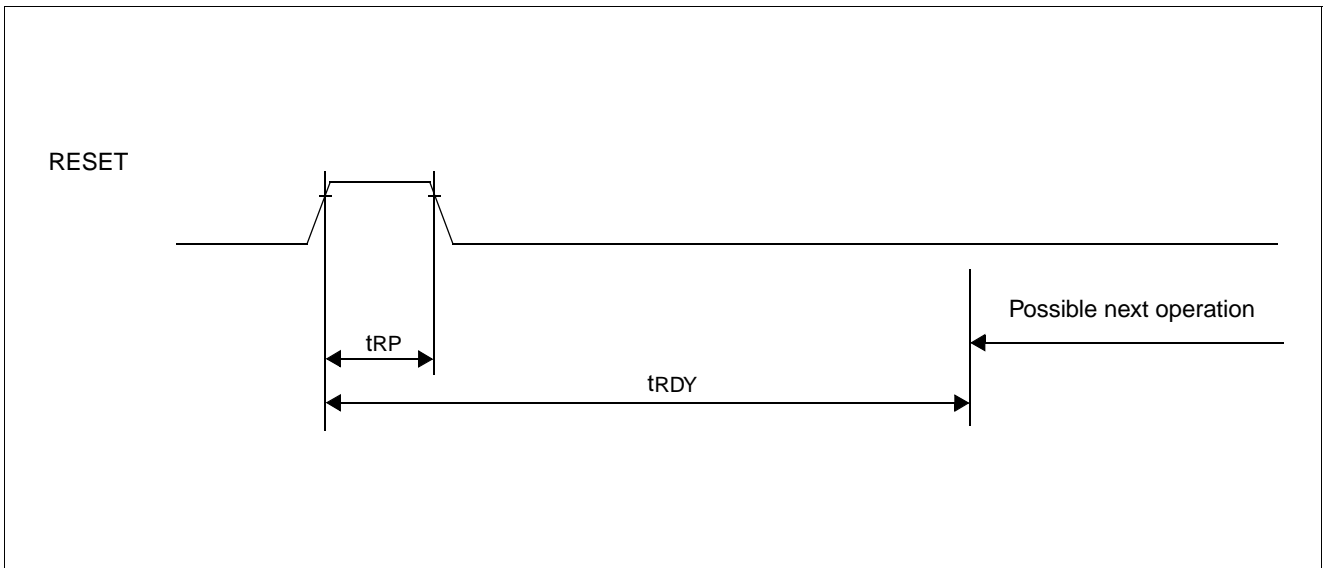
■ AC CHARACTERISTICS (Continued)

(Recommended operating conditions unless otherwise noted.)

R/B Timing Diagram During Program / Erase Operations (except for MB98A81063)



RESET Timing Diagram (except for MB98A81063)



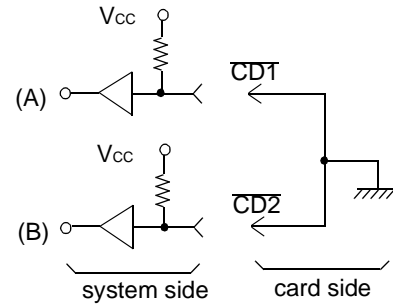
■ UNIQUE FEATURES FOR FLASH MEMORY CARD

1. SPECIAL MONITORING PINS

1.1 CD1, CD2: Card Detection Pins

$\overline{CD1}$ and $\overline{CD2}$ are to detect whether or not the card has been correctly inserted. (See Fig. 12.)

When the memory card has been correctly inserted, $\overline{CD1}$ and $\overline{CD2}$ are detected by the system. $\overline{CD1}$, $\overline{CD2}$ are tied to ground on the card side as shown in Fig. 12.



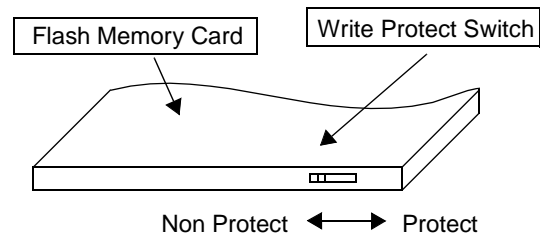
- Fig. 12-

1.2 WP: Write Protect Pins

This pin monitors the position of the Write Protect switch. As shown in Fig. 13, the Flash memory card has a Write Protect switch at the top of the card (except for MB98A81674).

To write to the card, the switch must be turned to the "Non Protect" position and the \overline{WE} pin low. And at that time, L-level is output on the WP pin.

To prevent writing to the card, the switch must be turned to the "Protect" position. At that time, H-level is output



- Fig. 13 -

WP Switch	WP (output)
Protect	H
Non Protect	L

MB98A81063-15/81183-15/81273-15/81373-15/81473-15/81573-15/81674-20

■ CARD INFORMATION

Memory Card have CIS (Card Information Structure) in Attribute memory.

1. CIS

Address	MB98A81063	MB98A81183	MB98A81273	MB98A81373	MB98A81473	MB98A81573	MB98A81674
0000 h	01 h						
0002 h	03 h						
0004 h	53 h						52 h
0006 h	0D h	1D h	0E h	1E h	3E h	7E h	FE h
0008 h	FF h						
000A h	15 h						
000C h	1C h						
000E h	04 h						
0010 h	01 h						
0012 h	46 h						
0014 h	55 h						
0016 h	4A h						
0018 h	49 h						
001A h	54 h						
001C h	53 h						
001E h	55 h						
0020 h	00 h						
0022 h	4D h						
0024 h	42 h						
0026 h	39 h						
0028 h	38 h						
002A h	41 h						
002C h	38 h						
002E h	30 h						
0030 h	30 h						
0032 h	36 h	38 h	37 h				
0034 h	33 h						34 h
0036 h	73 h						
0038 h	65 h						
003A h	72 h						
003C h	69 h						

(Continued)

MB98A81063-15/81183-15/81273-15/81373-15/81473-15/81573-15/81674-20

(Continued)

Address	MB98A81063	MB98A81183	MB98A81273	MB98A81373	MB98A81473	MB98A81573	MB98A81674
003E h				65 h			
0040 h				73 h			
0042 h				00 h			
0044 h				FF h			
0046 h				17 h			
0048 h				03 h			
004A h				41 h			
004C h				01 h			
004E h				FF h			
0050 h				18 h			
0052 h				03 h			
0054 h				04 h			
0056 h	A4 h	D5 h			3D h		
0058 h				FF h			
005A h				1E h			
005C h				07 h			
005E h				02 h			
0060 h				11 h			
0062 h				01 h			
0064 h				01 h			
0066 h				01 h			
0068 h				01 h			
006A h				FF h			
006C h				10 h			
006E h				06 h			
0070 h				CA h			
0072 h				FF h			
0074 h				3C h			
0076 h				00 h			
0078 h	02 h	45 h	9D h	AD h	CD h	0D h	8D h
007A h				FF h			
007C h				FF h			

2. Explanation for CIS

Address	MB98A81573	Attribute
0000 h	01 h	Common memory device information tuple
0002 h	03 h	Link to next tuple
0004 h	53 h	Flash memory with 150 ns access time
0006 h	7E h	32MB device size
0008 h	FF h	End of list
000A h	15 h	Level 1 version/product - information tuple
000C h	1C h	Link to next tuple
000E h	04 h	Conformed to JEIDA Ver.4.2/PCMCIA 2.1 Product/Maker Information for "FUJITSU MB98A80070 series"
0010 h	01 h	
0012 h	46 h	
0014 h	55 h	
0016 h	4A h	
0018 h	49 h	
001A h	54 h	
001C h	53 h	
001E h	55 h	
0020 h	00 h	
0022 h	4D h	
0024 h	42 h	
0026 h	39 h	
0028 h	38 h	
002A h	41 h	
002C h	38 h	
002E h	30 h	
0030 h	30 h	
0032 h	37 h	
0034 h	33 h	
0036 h	73 h	
0038 h	65 h	
003A h	72 h	
003C h	69 h	
003E h	65 h	
0040 h	73 h	

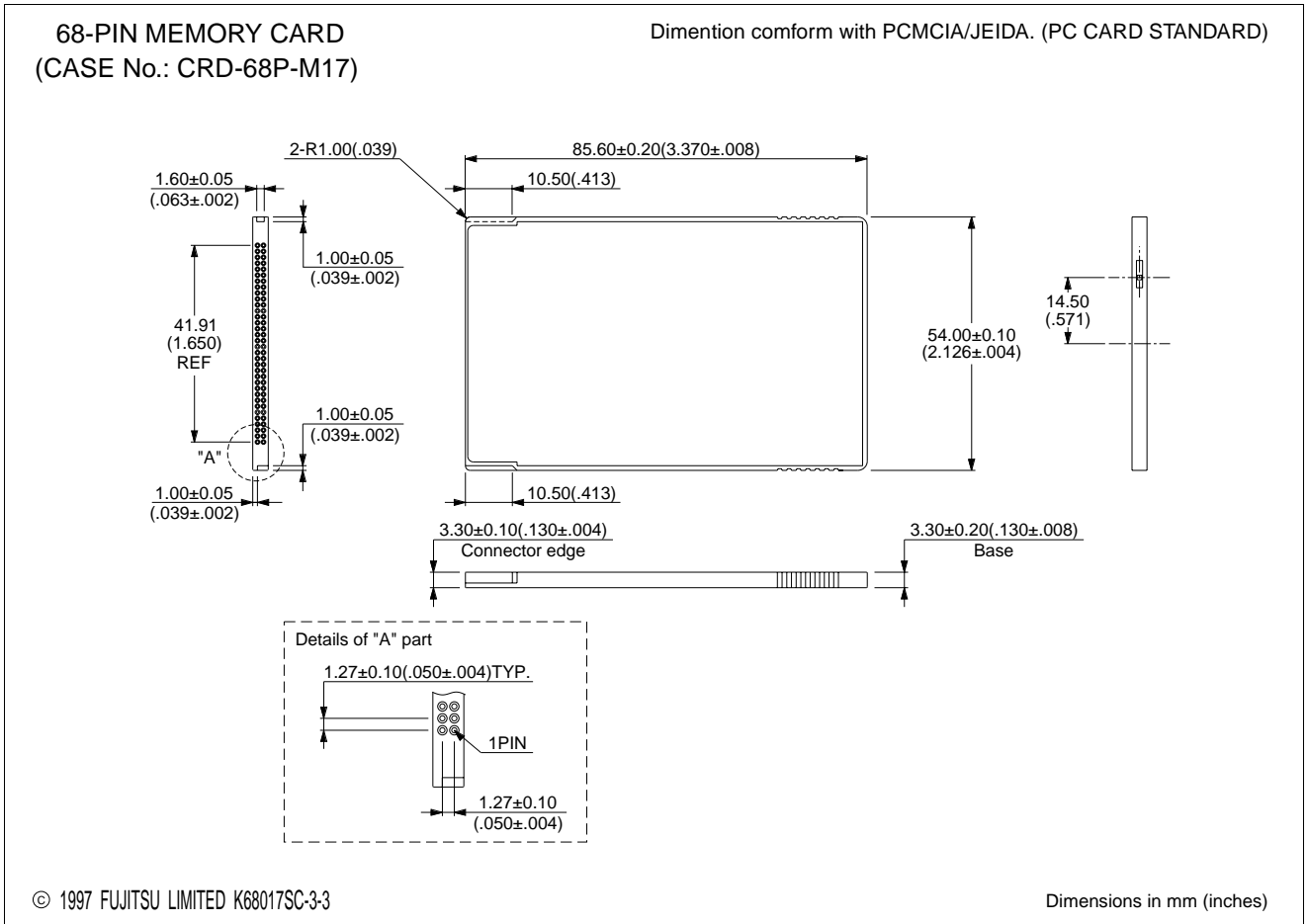
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MB98A81063-15/81183-15/81273-15/81373-15/81473-15/81573-15/81674-20

(Continued)

Address	MB98A81573	Attribute
0042 h	00 h	
0044 h	FF h	End of list
0046 h	17 h	Attribute memory device information tuple
0048 h	03 h	Link to next tuple
004A h	41 h	EEPROM with 250 ns access time
004C h	01 h	2 KB device size
004E h	FF h	End of list
0050 h	18 h	JEDEC device ID tuple for common memory
0052 h	03 h	Link to next tuple
0054 h	04 h	Manufacture ID
0056 h	3D h	Device ID
0058 h	FF h	End of list
005A h	1E h	Device geometry information for common memory device tuple
005C h	07 h	Link to next tuple
005E h	02 h	System bus width is 2 Bytes
0060 h	11 h	Erase block size is 64 KBytes
0062 h	01 h	Read block size is 1 Byte
0064 h	01 h	Program block size is 1 Byte
0066 h	01 h	No special partitioning requirements
0068 h	01 h	Non interleaved
006A h	FF h	End of list
006C h	10 h	Checksum tuple
006E h	06 h	Link to next tuple
0070 h	CA h	Offset to checksum area
0072 h	FF h	
0074 h	3C h	Length of check
0076 h	00 h	
0078 h	0D h	Checksum
007A h	FF h	End of list
007C h	FF h	The end of chain tuple

■ PACKAGE DIMENSIONS

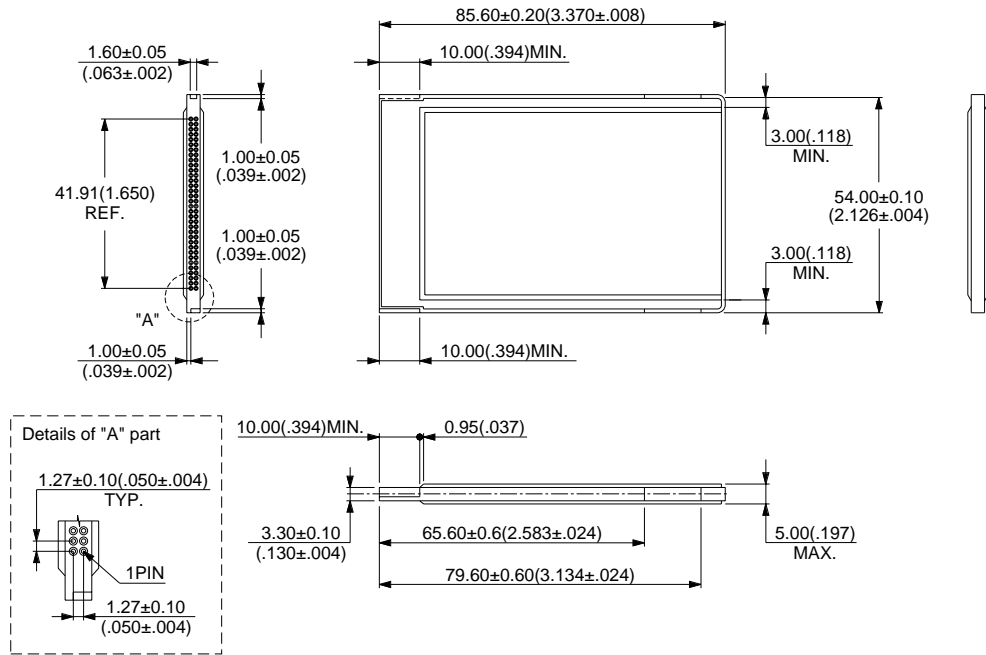


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68-PIN MEMORY CARD
(CASE No.: CRD-68P-M29)

Dimension conform with PCMCIA/JEIDA. (PC CARD STANDARD)
PRELIMINARY



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Dimensions in mm (inches)

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