FUJITSU SEMICONDUCTOR
DATA SHEET

DS05-50104-2E

MCP (Multi-Chip Package) FLASH MEMORY & SRAM

CMOS

16M (×16) FLASH MEMORY & 2M (× 8) STATIC RAM

MB84VA2102-10/MB84VA2103-10

■ FEATURES

- **Power supply voltage of 2.7 to 3.6 V**
- **High performance**
  100 ns maximum access time
- **Operating Temperature**
  –20 to +85°C

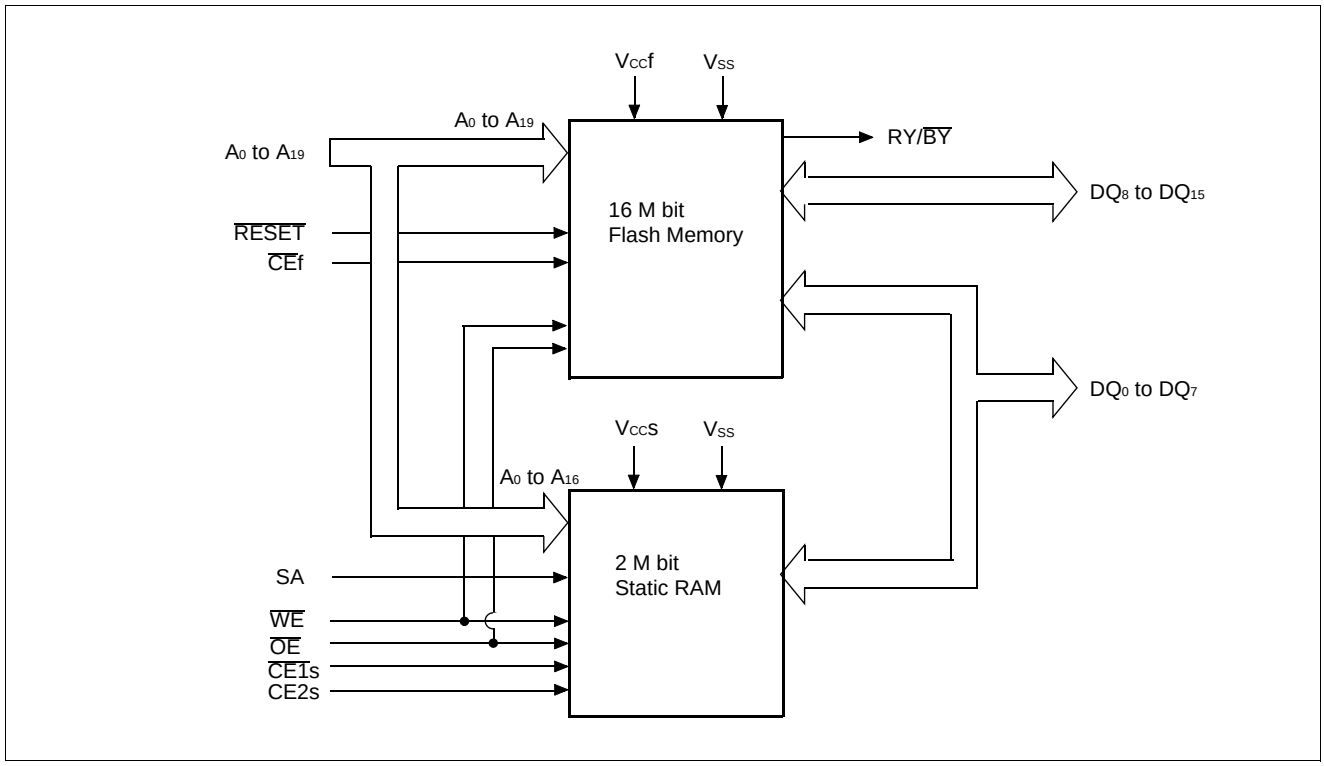
— FLASH MEMORY

- **Minimum 100,000 write/erase cycles**
- **Sector erase architecture**
  One 8 K word, two 4 K words, one 16 K word, and thirty one 32 K words.
  Any combination of sectors can be concurrently erased. Also supports full chip erase.
- **Boot Code Sector Architecture**
  MB84VA2102: Top sector
  MB84VA2103: Bottom sector
- **Embedded Erase™ Algorithms**
  Automatically pre-programs and erases the chip or any sector
- **Embedded Program™ Algorithms**
  Automatically writes and verifies data at specified address
- **$\overline{\text{Data}}$ Polling and Toggle Bit feature for detection of program or erase cycle completion**
- **Ready-Busy output (RY/$\overline{\text{BY}}$)**
  Hardware method for detection of program or erase cycle completion
- **Automatic sleep mode**
  When addresses remain stable, automatically switch themselves to low power mode.
- **Low V_{CC} write inhibit ≤ 2.5 V**
- **Erase Suspend/Resume**
  Suspends the erase operation to allow a read in another sector within the same device
  Please refer to "MBM29LV160T/B" data sheet in detailed function

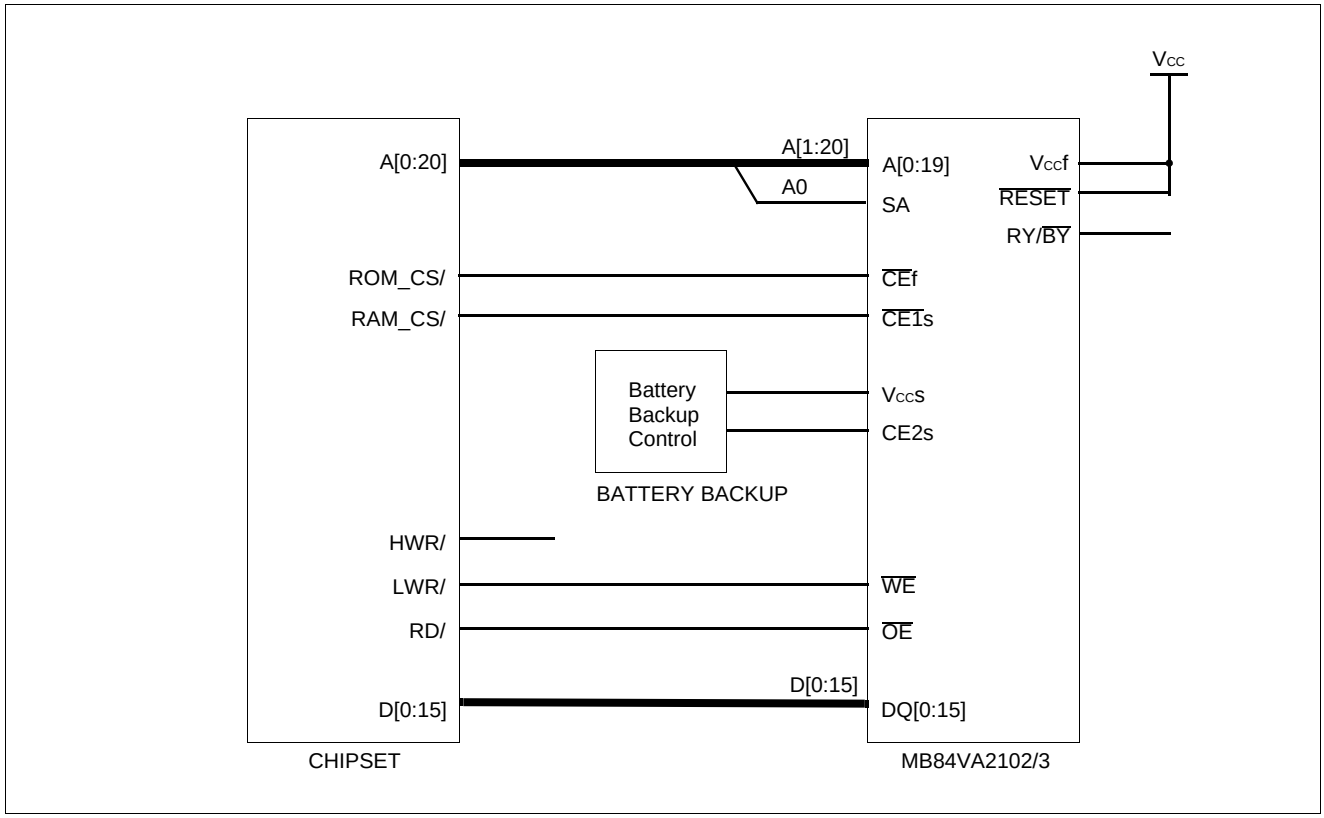
— SRAM

- **Power dissipation**
  Operating : 35 mA max.
  Standby : 50 µA max.
- **Power down features using $\overline{\text{CE1}}$s and CE2s**
- **Data retention supply voltage: 2.0 V to 3.6 V**

■ BLOCK DIAGRAM



■ EXAMPLE OF CONNECTION WITH CHIPSET



■ PIN ASSIGNMENTS

(Top View)

	A	B	C	D	E	F	G	H
6	$\overline{CE1}$s	V_{SS}	DQ_1	A_1	A_2	A_4	CE2s	A_9
5	A_{10}	DQ_5	DQ_2	A_0	A_3	A_7	RY/$\overline{BY}$	A_{14}
4	$\overline{OE}$	DQ_7	DQ_4	DQ_0	A_6	A_{18}	$\overline{RESET}$	A_{15}
3	A_{11}	A_8	A_5	DQ_8	DQ_3	DQ_{12}	A_{12}	A_{19}
2	A_{13}	A_{17}	SA*	$\overline{CE}$f	DQ_{10}	V_{CC}f	DQ_6	DQ_{15}/A_{-1}
1	$\overline{WE}$	V_{CC}s	A_{16}	V_{SS}	DQ_9	DQ_{11}	DQ_{13}	DQ_{14}

*: A_{17} for SRAM

Table 1 Pin Configuration

Pin	Function	Input/ Output
A_0 to A_{16}	Address Inputs (Common)	I
A_{17} to A_{19}	Address Input (Flash)	I
SA	Address Input (SRAM)	I
DQ_0 to DQ_7	Data Inputs/Outputs (Common)	I/O
DQ_8 to DQ_{15}	Data Inputs/Outputs (Flash)	I/O
$\overline{CE}$f	Chip Enable (Flash)	I
$\overline{CE1}$s	Chip Enable (SRAM)	I
CE2s	Chip Enable (SRAM)	I
$\overline{OE}$	Output Enable (Common)	I
$\overline{WE}$	Write Enable (Common)	I
RY/$\overline{BY}$	Ready/Busy Outputs (Flash)	O
$\overline{RESET}$	Hardware Reset Pin/Sector Protection Unlock (Flash)	I
N.C.	No Internal Connection	—
V_{SS}	Device Ground (Common)	Power
V_{CC}f	Device Power Supply (Flash)	Power
V_{CC}s	Device Power Supply (SRAM)	Power

■ PRODUCT LINE UP

		Flash Memory	SRAM
Ordering Part No.	V_{CC} = 3.0 V $^{+0.6\ V}_{-0.3\ V}$	MB84VA2102-10/MB84VA2103-10	
Max. Address Access Time (ns)		100	100
Max. $\overline{CE}$ Access Time (ns)		100	100
Max. $\overline{OE}$ Access Time (ns)		40	50

■ BUS OPERATIONS

Table 2 User Bus Operations

Operation (1), (3)	$\overline{CE}$f	$\overline{CE1}$s	CE2s	$\overline{OE}$	$\overline{WE}$	DQ_0 to DQ_7	DQ_8 to DQ_{15}	$\overline{RESET}$
Full Standby	H	H	X	X	X	HIGH-Z	HIGH-Z	H
		X	L					
Output Disable	X	X	X	H	H	HIGH-Z	HIGH-Z	H
Read from Flash (2)	L	H	X	L	H	D_{OUT}	D_{OUT}	H
		X	L					
Write to Flash	L	H	X	H	L	D_{IN}	D_{IN}	H
		X	L					
Read from SRAM	H	L	H	L	H	D_{OUT}	HIGH-Z	H
Write to SRAM	H	L	H	X	L	D_{IN}	HIGH-Z	H
Flash Hardware Reset	X	H	X	X	X	HIGH-Z	HIGH-Z	L
		X	L					

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

Notes: 1. Other operations except for indicated this column are inhibited.
2. $\overline{WE}$ can be V_{IL} if $\overline{OE}$ is V_{IL}, $\overline{OE}$ at V_{IH} initiates the write operations.
3. Do not apply $\overline{CE}$f = V_{IL}, $\overline{CE1}$s = V_{IL} and CE2s = V_{IH} at a time.

■ FLEXIBLE SECTOR-ERASE ARCHITECTURE on FLASH MEMORY

•One 8 K word, two 4 K words, one 16 K word, and thirty one 32 K words.
•Individual-sector, multiple-sector, or bulk-erase capability.

Sector	Sector Size	Address Range
SA0	32K Words	00000H to 07FFFH
SA1	32K Words	08000H to 0FFFFH
SA2	32K Words	10000H to 17FFFH
SA3	32K Words	18000H to 1FFFFH
SA4	32K Words	20000H to 27FFFH
SA5	32K Words	28000H to 2FFFFH
SA6	32K Words	30000H to 37FFFH
SA7	32K Words	38000H to 3FFFFH
SA8	32K Words	40000H to 47FFFH
SA9	32K Words	48000H to 4FFFFH
SA10	32K Words	50000H to 57FFFH
SA11	32K Words	58000H to 5FFFFH
SA12	32K Words	60000H to 67FFFH
SA13	32K Words	68000H to 6FFFFH
SA14	32K Words	70000H to 77FFFH
SA15	32K Words	78000H to 7FFFFH
SA16	32K Words	80000H to 87FFFH
SA17	32K Words	88000H to 8FFFFH
SA18	32K Words	90000H to 97FFFH
SA19	32K Words	98000H to 9FFFFH
SA20	32K Words	A0000H to A7FFFH
SA21	32K Words	A8000H to AFFFFH
SA22	32K Words	B0000H to B7FFFH
SA23	32K Words	B8000H to BFFFFH
SA24	32K Words	C0000H to C7FFFH
SA25	32K Words	C8000H to CFFFFH
SA26	32K Words	D0000H to D7FFFH
SA27	32K Words	D8000H to DFFFFH
SA28	32K Words	E0000H to E7FFFH
SA29	32K Words	E8000H to EFFFFH
SA30	32K Words	F0000H to F7FFFH
SA31	16K Words	F8000H to FBFFFH
SA32	4K Words	FC000H to FCFFFH
SA33	4K Words	FD000H to FDFFFH
SA34	8K Words	FE000H to FFFFFH

MB84VA2102 Sector Architecture

Sector	Sector Size	Address Range
SA0	8K Words	00000H to 01FFFH
SA1	4K Words	02000H to 02FFFH
SA2	4K Words	03000H to 03FFFH
SA3	16K Words	04000H to 07FFFH
SA4	32K Words	08000H to 0FFFFH
SA5	32K Words	10000H to 17FFFH
SA6	32K Words	18000H to 1FFFFH
SA7	32K Words	20000H to 27FFFH
SA8	32K Words	28000H to 2FFFFH
SA9	32K Words	30000H to 37FFFH
SA10	32K Words	38000H to 3FFFFH
SA11	32K Words	40000H to 47FFFH
SA12	32K Words	48000H to 4FFFFH
SA13	32K Words	50000H to 57FFFH
SA14	32K Words	58000H to 5FFFFH
SA15	32K Words	60000H to 67FFFH
SA16	32K Words	68000H to 6FFFFH
SA17	32K Words	70000H to 77FFFH
SA18	32K Words	78000H to 7FFFFH
SA19	32K Words	80000H to 87FFFH
SA20	32K Words	88000H to 8FFFFH
SA21	32K Words	90000H to 97FFFH
SA22	32K Words	98000H to 9FFFFH
SA23	32K Words	A0000H to A7FFFH
SA24	32K Words	A8000H to AFFFFH
SA25	32K Words	B0000H to B7FFFH
SA26	32K Words	B8000H to BFFFFH
SA27	32K Words	C0000H to C7FFFH
SA28	32K Words	C8000H to CFFFFH
SA29	32K Words	D0000H to D7FFFH
SA30	32K Words	D8000H to DFFFFH
SA31	32K Words	E0000H to E7FFFH
SA32	32K Words	E8000H to EFFFFH
SA33	32K Words	F0000H to F7FFFH
SA34	32K Words	F8000H to FFFFFH

MB84VA2103 Sector Architecture

Table 3 Sector Address Tables (MB84VA2102)

Sector Address	A_{19}	A_{18}	A_{17}	A_{16}	A_{15}	A_{14}	A_{13}	A_{12}	Address Range
SA0	0	0	0	0	0	X	X	X	00000H to 07FFFH
SA1	0	0	0	0	1	X	X	X	08000H to 0FFFFH
SA2	0	0	0	1	0	X	X	X	10000H to 17FFFH
SA3	0	0	0	1	1	X	X	X	18000H to 1FFFFH
SA4	0	0	1	0	0	X	X	X	20000H to 27FFFH
SA5	0	0	1	0	1	X	X	X	28000H to 2FFFFH
SA6	0	0	1	1	0	X	X	X	30000H to 37FFFH
SA7	0	0	1	1	1	X	X	X	38000H to 3FFFFH
SA8	0	1	0	0	0	X	X	X	40000H to 47FFFH
SA9	0	1	0	0	1	X	X	X	48000H to 4FFFFH
SA10	0	1	0	1	0	X	X	X	50000H to 57FFFH
SA11	0	1	0	1	1	X	X	X	58000H to 5FFFFH
SA12	0	1	1	0	0	X	X	X	60000H to 67FFFH
SA13	0	1	1	0	1	X	X	X	68000H to 6FFFFH
SA14	0	1	1	1	0	X	X	X	70000H to 77FFFH
SA15	0	1	1	1	1	X	X	X	78000H to 7FFFFH
SA16	1	0	0	0	0	X	X	X	80000H to 87FFFH
SA17	1	0	0	0	1	X	X	X	88000H to 8FFFFH
SA18	1	0	0	1	0	X	X	X	90000H to 97FFFH
SA19	1	0	0	1	1	X	X	X	98000H to 9FFFFH
SA20	1	0	1	0	0	X	X	X	A0000H to A7FFFH
SA21	1	0	1	0	1	X	X	X	A8000H to AFFFFH
SA22	1	0	1	1	0	X	X	X	B0000H to B7FFFH
SA23	1	0	1	1	1	X	X	X	B8000H to BFFFFH
SA24	1	1	0	0	0	X	X	X	C0000H to C7FFFH
SA25	1	1	0	0	1	X	X	X	C8000H to CFFFFH
SA26	1	1	0	1	0	X	X	X	D0000H to D7FFFH
SA27	1	1	0	1	1	X	X	X	D8000H to DFFFFH
SA28	1	1	1	0	0	X	X	X	E0000H to E7FFFH
SA29	1	1	1	0	1	X	X	X	E8000H to EFFFFH
SA30	1	1	1	1	0	X	X	X	F0000H to F7FFFH
SA31	1	1	1	1	1	0	X	X	F8000H to FBFFFH
SA32	1	1	1	1	1	1	0	0	FC000H to FCFFFH
SA33	1	1	1	1	1	1	0	1	FD000H to FDFFFH
SA34	1	1	1	1	1	1	1	X	FE000H to FFFFFH

Table 4 Sector Address Tables (MB84VA2103)

Sector Address	A_{19}	A_{18}	A_{17}	A_{16}	A_{15}	A_{14}	A_{13}	A_{12}	Address Range
SA0	0	0	0	0	0	0	0	X	00000H to 01FFFH
SA1	0	0	0	0	0	0	1	0	02000H to 02FFFH
SA2	0	0	0	0	0	0	1	1	03000H to 03FFFH
SA3	0	0	0	0	0	1	0	X	04000H to 07FFFH
SA4	0	0	0	0	1	X	X	X	08000H to 0FFFFH
SA5	0	0	0	1	0	X	X	X	10000H to 17FFFH
SA6	0	0	0	1	1	X	X	X	18000H to 1FFFFH
SA7	0	0	1	0	0	X	X	X	20000H to 27FFFH
SA8	0	0	1	0	1	X	X	X	28000H to 2FFFFH
SA9	0	0	1	1	0	X	X	X	30000H to 37FFFH
SA10	0	0	1	1	1	X	X	X	38000H to 3FFFFH
SA11	0	1	0	0	0	X	X	X	40000H to 47FFFH
SA12	0	1	0	0	1	X	X	X	48000H to 4FFFFH
SA13	0	1	0	1	0	X	X	X	50000H to 57FFFH
SA14	0	1	0	1	1	X	X	X	58000H to 5FFFFH
SA15	0	1	1	0	0	X	X	X	60000H to 67FFFH
SA16	0	1	1	0	1	X	X	X	68000H to 6FFFFH
SA17	0	1	1	1	0	X	X	X	70000H to 77FFFH
SA18	0	1	1	1	1	X	X	X	78000H to 7FFFFH
SA19	1	0	0	0	0	X	X	X	80000H to 87FFFH
SA20	1	0	0	0	1	X	X	X	88000H to 8FFFFH
SA21	1	0	0	1	0	X	X	X	90000H to 97FFFH
SA22	1	0	0	1	1	X	X	X	98000H to 9FFFFH
SA23	1	0	1	0	0	X	X	X	A0000H to A7FFFH
SA24	1	0	1	0	1	X	X	X	A8000H to 8FFFFH
SA25	1	0	1	1	0	X	X	X	B0000H to B7FFFH
SA26	1	0	1	1	1	X	X	X	B8000H to BFFFFH
SA27	1	1	0	0	0	X	X	X	C0000H to C7FFFH
SA28	1	1	0	0	1	X	X	X	C8000H to CFFFFH
SA29	1	1	0	1	0	X	X	X	D0000H to D7FFFH
SA30	1	1	0	1	1	X	X	X	D8000H to DFFFFH
SA31	1	1	1	0	0	X	X	X	E0000H to E7FFFH
SA32	1	1	1	0	1	X	X	X	E8000H to EFFFFH
SA33	1	1	1	1	0	X	X	X	F0000H to F7FFFH
SA34	1	1	1	1	1	X	X	X	F8000H to FFFFFH

Table 5. 1 Flash Memory Autoselect Codes

Type		A_6	A_1	A_0	Code (HEX)
Manufacturer's Code		V_{IL}	V_{IL}	V_{IL}	04H
Device Code	MB84VA2102	V_{IL}	V_{IL}	V_{IH}	22C4H
	MB84VA2103	V_{IL}	V_{IL}	V_{IH}	2249H

Table 5. 2 Expanded Autoselect Code Table

Type		Code	DQ_{15}	DQ_{14}	DQ_{13}	DQ_{12}	DQ_{11}	DQ_{10}	DQ_9	DQ_8	DQ_7	DQ_6	DQ_5	DQ_4	DQ_3	DQ_2	DQ_1	DQ_0
Manufacturer's Code		04H	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Device Code	MB84VA2102	22C4H	0	0	1	0	0	0	1	0	1	1	0	0	0	1	0	0
	MB84VA2103	2249H	0	0	1	0	0	0	1	0	0	1	0	0	1	0	0	1

Table 6 Flash Memory Command Definitions

Command Sequence	Bus Write Cycles Req'd	First Bus Write Cycle		Second Bus Write Cycle		Third Bus Write Cycle		Fourth Bus Read/Write Cycle		Fifth Bus Write Cycle		Sixth Bus Write Cycle	
		Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data
Read/Reset	1	XXXH	F0H	—	—	—	—	—	—	—	—	—	—
Read/Reset	3	555H	AAH	2AAH	55H	555H	F0H	RA	RD	—	—	—	—
Autoselect	3	555H	AAH	2AAH	55H	555H	90H	—	—	—	—	—	—
Program	4	555H	AAH	2AAH	55H	555H	A0H	PA	PD	—	—	—	—
Chip Erase	6	555H	AAH	2AAH	55H	555H	80H	555H	AAH	2AAH	55H	555H	10H
Sector Erase	6	555H	AAH	2AAH	55H	555H	80H	555H	AAH	2AAH	55H	SA	30H
Sector Erase Suspend		Erase can be suspended during sector erase with Addr. ("H" or "L"). Data (B0H)											
Sector Erase Resume		Erase can be resumed after suspend with Addr. ("H" or "L"). Data (30H)											
Set to Fast Mode	3	555H	AAH	2AAH	55H	555H	20H	—	—	—	—	—	—
Fast Program (Note)	2	XXXH	A0H	PA	PD	—	—	—	—	—	—	—	—
Reset from Fast Mode (Note)	2	XXXH	90H	XXXH	F0H	—	—	—	—	—	—	—	—
Extended Sector Protect	4	XXXH	60H	SPA	60H	SPA	40H	SPA	SD	—	—	—	—

Address bits A_{11} to A_{20} = X = "H" or "L" for all address commands except for Program Address (PA) and Sector Address (SA).
Bus operations are defined in Table 2.
Both Read/Reset commands are functionally equivalent, resetting the device to the read mode.

RA =Address of the memory location to be read.
PA =Address of the memory location to be programmed. Addresses are latched on the falling edge of the write pulse.
SA =Address of the sector to be erased. The combination of A_{20}, A_{19}, A_{18}, A_{17}, A_{16}, A_{15}, A_{14}, and A_{13} will uniquely select any sector.
RD =Data read from location RA during read operation.
PD =Data to be programmed at location PA.
SPA =Sector address to be protected. Set sector address (SA) and (A_6, A_1, A_0) = (0, 1, 0).
SD =Sector protection verify data. Output 01H at protected sector addresses and output 00H at unprotected sector addresses.

Note: This command is valid while Fast Mode.

■ ABSOLUTE MAXIMUM RATINGS

Storage Temperature ..... –55°C to +125°C
Ambient Temperature with Power Applied ..... –25°C to +85°C
Voltage with Respect to Ground All pins (Note) ..... –0.3 V to V_{CC}f +0.5 V
–0.3 V to V_{CC}s +0.5 V
V_{CC}f/V_{CC}s Supply (Note) ..... –0.3 V to +4.6 V

Note: Minimum DC voltage on input or I/O pins are –0.5 V. During voltage transitions, inputs may negative overshoot V_{SS} to –2.0 V for periods of up to 20 ns. Maximum DC voltage on output and I/O pins are V_{CC}f +0.5 V or V_{CC}s +0.5 V. During voltage transitions, outputs may positive overshoot to V_{CC} +2.0 V for periods of up to 20 ns.

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 RANGES

Commercial Devices
Ambient Temperature (T_A) ..... –20°C to +85°C

V_{CC}f/V_{CC}s Supply Voltages ..... +2.7 V to +3.6 V

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

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.

■ DC CHARACTERISTICS

Parameter Symbol	Parameter Description	Test Conditions			Min.	Typ.	Max.	Unit
I_{LI}	Input Leakage Current	—			–1.0	—	+1.0	µA
I_{LO}	Output Leakage Current	—			–1.0	—	+1.0	µA
$I_{CC1}f$	Flash V_{CC} Active Current (Read)	$V_{CC}f$ = V_{CC} Max., $\overline{CE}f$ = V_{IL}, $\overline{OE}$ = V_{IH}		t_{CYCLE} = 10 MHz	—	—	35	mA
				t_{CYCLE} = 5 MHz	—	—	17	
$I_{CC2}f$	Flash V_{CC} Active Current (Program/Erase)	$V_{CC}f$ = V_{CC} Max., $\overline{CE}f$ = V_{IL}, $\overline{OE}$ = V_{IH}			—	—	35	mA
$I_{CC1}s$	SRAM V_{CC} Active Current	$V_{CC}s$ = V_{CC} Max., $\overline{CE1}s$ = V_{IL}, CE2s = V_{IH}		t_{CYCLE} =10 MHz	—	—	40	mA
				t_{CYCLE} = 1 MHz	—	—	12	mA
$I_{CC2}s$	SRAM V_{CC} Active Current	$\overline{CE1}s$ = 0.2 V, CE2s = $V_{CC}s$ – 0.2 V, $\overline{WE}$ = $V_{CC}s$ – 0.2 V		t_{CYCLE} = 10 MHz	—	—	35	mA
				t_{CYCLE} = 1 MHz	—	—	6	mA
$I_{SB1}f$	Flash V_{CC} Standby Current	$V_{CC}f$ = V_{CC} Max., $\overline{CE}f$ = $V_{CC}f$ ± 0.3 V, $\overline{RESET}$ = $V_{CC}f$ ± 0.3 V			—	—	5	µA
$I_{SB2}f$	Flash V_{CC} Standby Current ($\overline{RESET}$)	$V_{CC}f$ = V_{CC} Max., $\overline{RESET}$ = V_{SS} ± 0.3 V			—	—	5	µA
$I_{SB1}s$	SRAM V_{CC} Standby Current	$\overline{CE1}s$ = V_{IH} or CE2s = V_{IL}			—	—	2	mA
$I_{SB2}s$**	SRAM V_{CC} Standby Current	$\overline{CE1}s$ = V_{CC} – 0.2 V or CE2s = 0.2 V	$V_{CC}s$ = 3.0 V ±10%	T_A = 25°C	—	1	2.5	µA
				T_A = –20 to +85°C	—	—	55	µA
			$V_{CC}s$ = 3.3 V ±0.3 V	T_A = 25°C	—	1.5	3	µA
				T_A = –20 to +85°C	—	—	60	µA
			$V_{CC}s$ = 3.0 V	T_A = 25°C	—	1	2	µA
				T_A = –20 to +40°C	—	—	5	µA
				T_A = –20 to +85°C	—	—	50	µA
V_{IL}	Input Low Level	—			–0.3	—	0.6	V
V_{IH}	Input High Level	—			2.2	—	V_{CC}+0.3*	V
V_{OL}	Output Low Voltage Level	I_{OL} = 2.1 mA, $V_{CC}f$ = $V_{CC}s$ = V_{CC} Min.			—	—	0.4	V
V_{OH}	Output High Voltage Level	I_{OH} = –500 µA, $V_{CC}f$ = $V_{CC}s$ = V_{CC} Min.			V_{CC} – 0.5	—	—	V
V_{LKO}	Flash Low V_{CC} Lock-Out Voltage	—			2.3	—	2.5	V

* : V_{CC} indicate lower of $V_{CC}f$ or $V_{CC}s$

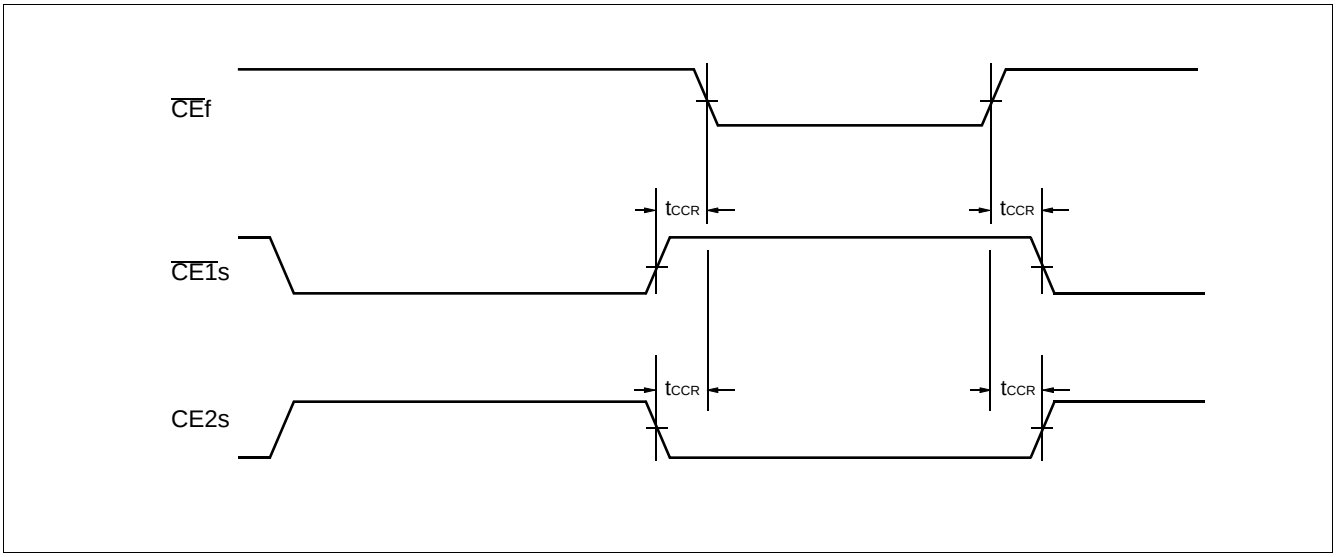
** :During standby mode with $\overline{CE1}s$ = V_{CCS} – 0.2 V, CE2s should be CE2s < 0.2V or CE2s > V_{CCS} – 0.2V

■ AC CHARACTERISTICS

- **$\overline{CE}$ Timing**

Parameter Symbols		Description	Test Setup		-10	Unit
JEDEC	Standard					
—	t_{CCR}	$\overline{CE}$ Recover Time	—	Min.	0	ns

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

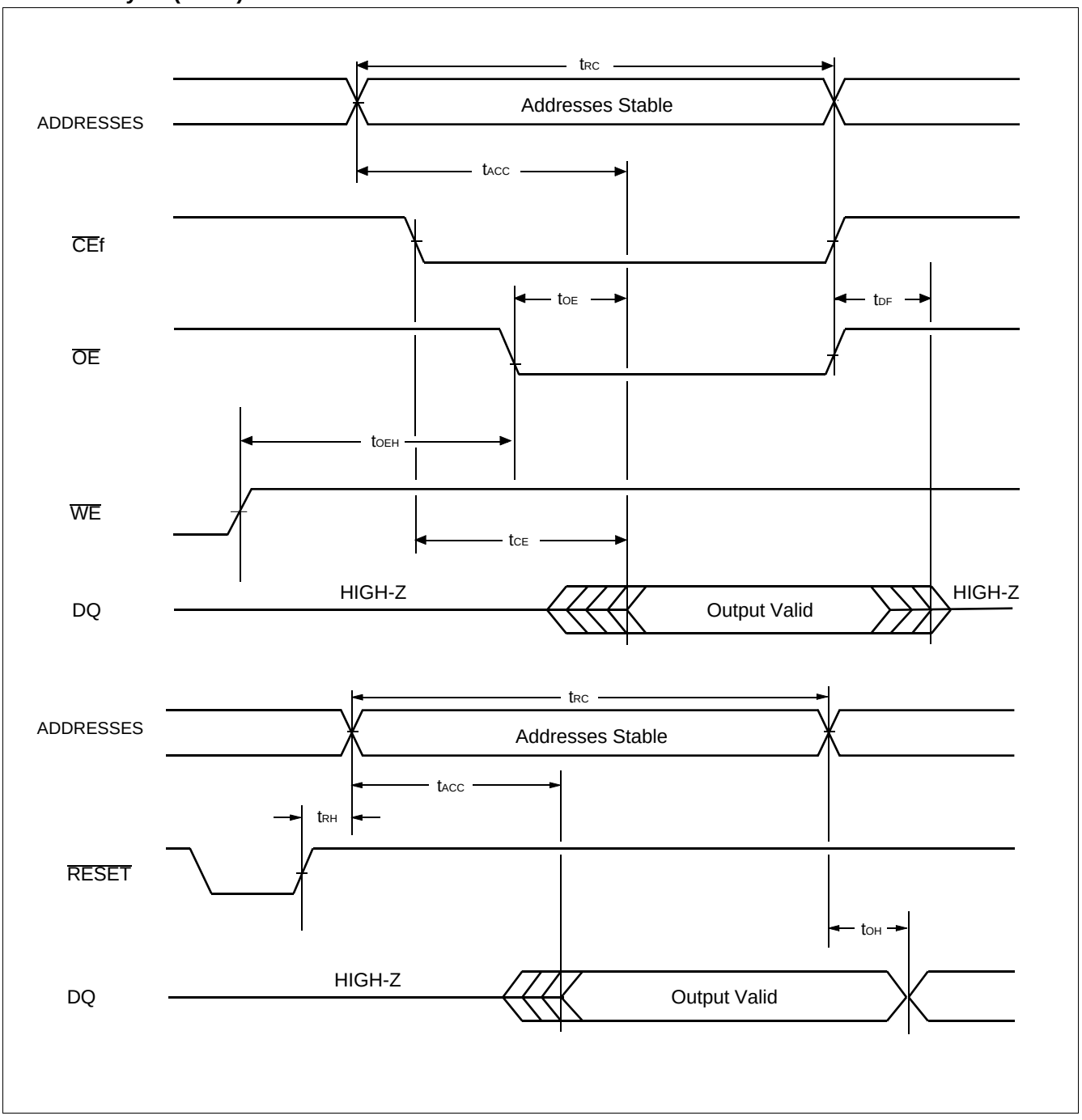


- **Read Only Operations Characteristics (Flash)**

Parameter Symbols		Description	Test Setup	-10 (Note)		Unit
JEDEC	Standard			Min.	Max.	
t_{AVAV}	t_{RC}	Read Cycle Time	—	100	—	ns
t_{AVQV}	t_{ACC}	Address to Output Delay	$\overline{CE}f = V_{IL}$ $\overline{OE} = V_{IL}$	—	100	ns
t_{ELQV}	$t_{CE}f$	Chip Enable to Output Delay	$\overline{OE} = V_{IL}$	—	100	ns
t_{GLQV}	t_{OE}	Output Enable to Output Delay	—	—	40	ns
t_{EHQZ}	t_{DF}	Chip Enable to Output High-Z	—	—	30	ns
t_{GHQZ}	t_{DF}	Output Enable to Output High-Z	—	—	30	ns
t_{AXQX}	t_{OH}	Output Hold Time From Addresses, $\overline{CE}f$ or $\overline{OE}$, Whichever Occurs First	—	0	—	ns
—	t_{READY}	$\overline{RESET}$ Pin Low to Read Mode	—	—	20	µs

Note: Test Conditions–Output Load: 1 TTL gate and 30 pF
Input rise and fall times: 5 ns
Input pulse levels: 0.0 V to 3.0 V
Timing measurement reference level
Input: 1.5 V
Output: 1.5 V

- **Read Cycle (Flash)**



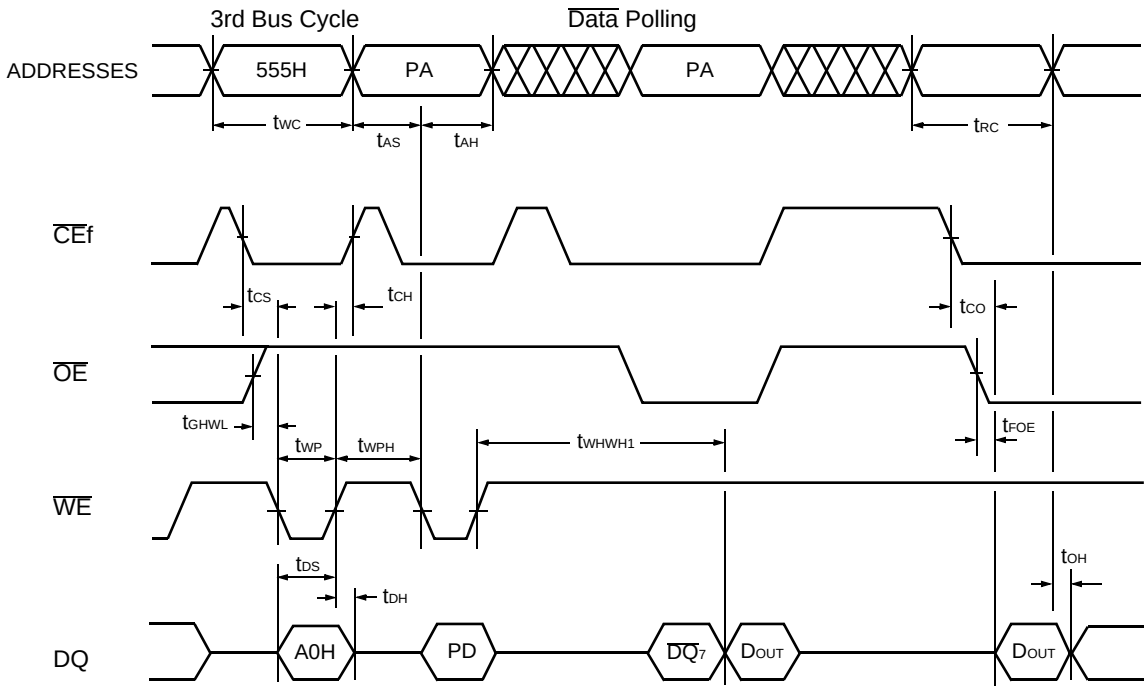
• **Erase/Program Operations (Flash)**

Parameter Symbols		Description		-10			Unit
JEDEC	Standard			Min.	Typ.	Max.	
t_{AVAV}	t_{WC}	Write Cycle Time		100	—	—	ns
t_{AVWL}	t_{AS}	Address Setup Time ($\overline{WE}$ to Addr.)		0	—	—	ns
t_{AVEL}	t_{AS}	Address Setup Time ($\overline{CE}$f to Addr.)		0	—	—	ns
t_{WLAX}	t_{AH}	Address Hold Time ($\overline{WE}$ to Addr.)		50	—	—	ns
t_{ELAX}	t_{AH}	Address Hold Time ($\overline{CE}$f to Addr.)		50	—	—	ns
t_{DVWH}	t_{DS}	Data Setup Time		50	—	—	ns
t_{WHDX}	t_{DH}	Data Hold Time		0	—	—	ns
—	t_{OES}	Output Enable Setup Time		0	—	—	ns
—	t_{OEH}	Output Enable Hold Time	Read	0	—	—	ns
			Toggle and $\overline{Data}$ Polling	10	—	—	ns
t_{GHEL}	t_{GHEL}	Read Recover Time Before Write ($\overline{OE}$ to $\overline{CE}$f)		0	—	—	ns
t_{GHWL}	t_{GHWL}	Read Recover Time Before Write ($\overline{OE}$ to $\overline{WE}$)		0	—	—	ns
t_{WLEL}	t_{WS}	$\overline{WE}$ Setup Time ($\overline{CE}$f to $\overline{WE}$)		0	—	—	ns
t_{ELWL}	t_{CS}	$\overline{CE}$f Setup Time ($\overline{WE}$ to $\overline{CE}$f)		0	—	—	ns
t_{EHWH}	t_{WH}	$\overline{WE}$ Hold Time ($\overline{CE}$f to $\overline{WE}$)		0	—	—	ns
t_{WHEH}	t_{CH}	$\overline{CE}$f Hold Time ($\overline{WE}$ to $\overline{CE}$f)		0	—	—	ns
t_{WLWH}	t_{WP}	Write Pulse Width		50	—	—	ns
t_{ELEH}	t_{CP}	$\overline{CE}$f Pulse Width		50	—	—	ns
t_{WHWL}	t_{WPH}	Write Pulse Width High		30	—	—	ns
t_{EHEL}	t_{CPH}	$\overline{CE}$f Pulse Width High		30	—	—	ns
t_{WHWH1}	t_{WHWH1}	Programming Operation		—	16	—	µs
t_{WHWH2}	t_{WHWH2}	Sector Erase Operation (Note 1)		—	1	—	sec
				—	—	15	sec
—	t_{VCS}	V_{CC}f Setup Time		50	—	—	µs
—	t_{VLHT}	Voltage Transition Time (Note 2)		4	—	—	µs
—	t_{VIDR}	Rise Time to V_{ID} (Note 2)		500	—	—	ns
—	t_{RB}	Recover Time from RY/$\overline{BY}$		0	—	—	ns
—	t_{RP}	$\overline{RESET}$ Pulse Width		500	—	—	ns
—	t_{RH}	$\overline{RESET}$ Hold Time Before Read		200	—	—	ns
—	t_{EOE}	Delay Time from Embedded Output Enable		—	—	100	ns
—	t_{BUSY}	Program/Erase Valid to RY/$\overline{BY}$ Delay		—	—	90	ns

Note : 1. This does not include the preprogramming time.

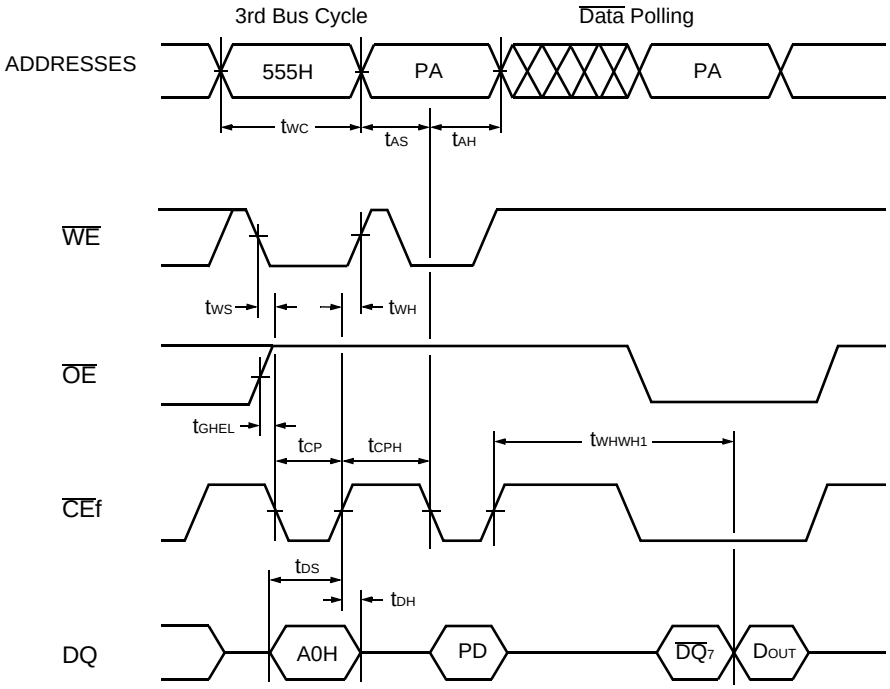
2. This timing is for Sector Protection Operation.

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



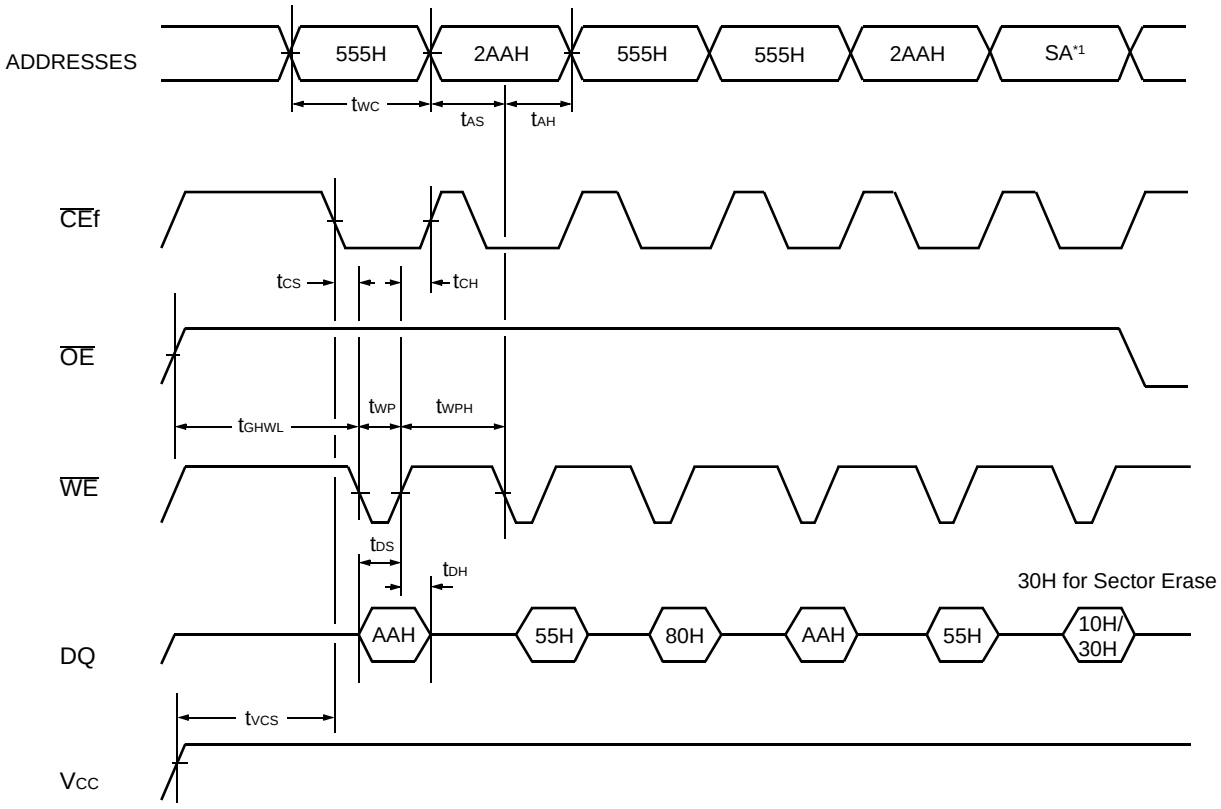
Notes: 1. PA is address of the memory location to be programmed.
2. PD is data to be programmed at byte address.
3. $\overline{DQ}_7$ is the output of the complement of the data written to the device.
4. D_{OUT} is the output of the data written to the device.
5. Figure indicates last two bus cycles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

- **Write Cycle ($\overline{CE}$f control) (Flash)**



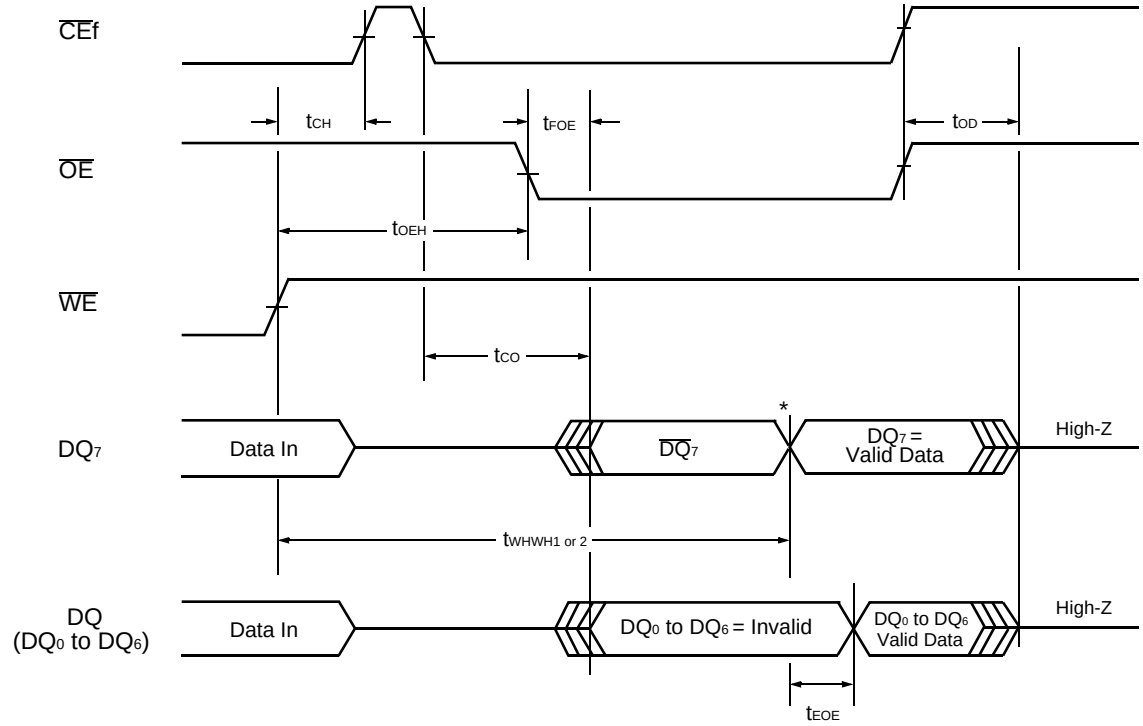
Notes: 1. PA is address of the memory location to be programmed.
2. PD is data to be programmed at byte address.
3. $\overline{DQ}_7$ is the output of the complement of the data written to the device.
4. D_{OUT} is the output of the data written to the device.
5. Figure indicates last two bus cycles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

- **AC Waveforms Chip/Sector Erase Operations (Flash)**



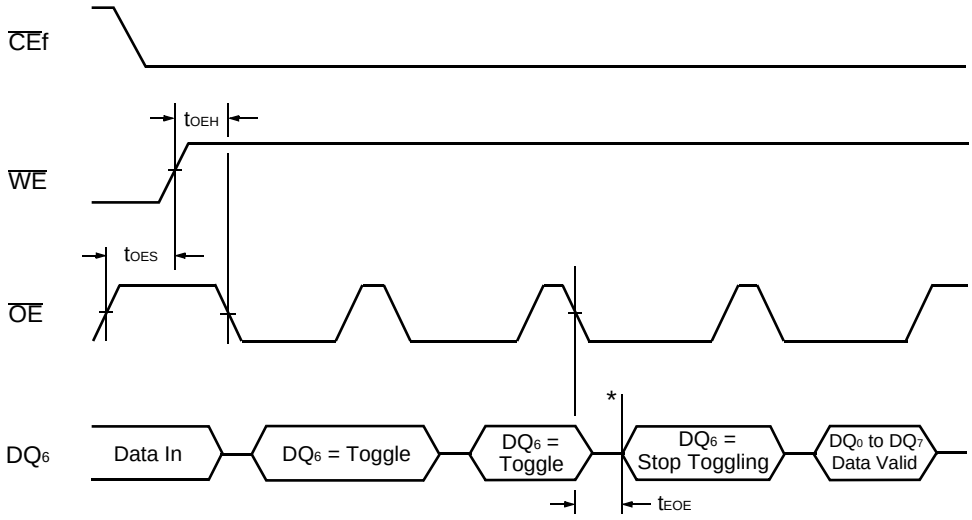
Notes: 1. SA is the sector address for Sector Erase. Addresses = 555H for Chip Erase.

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



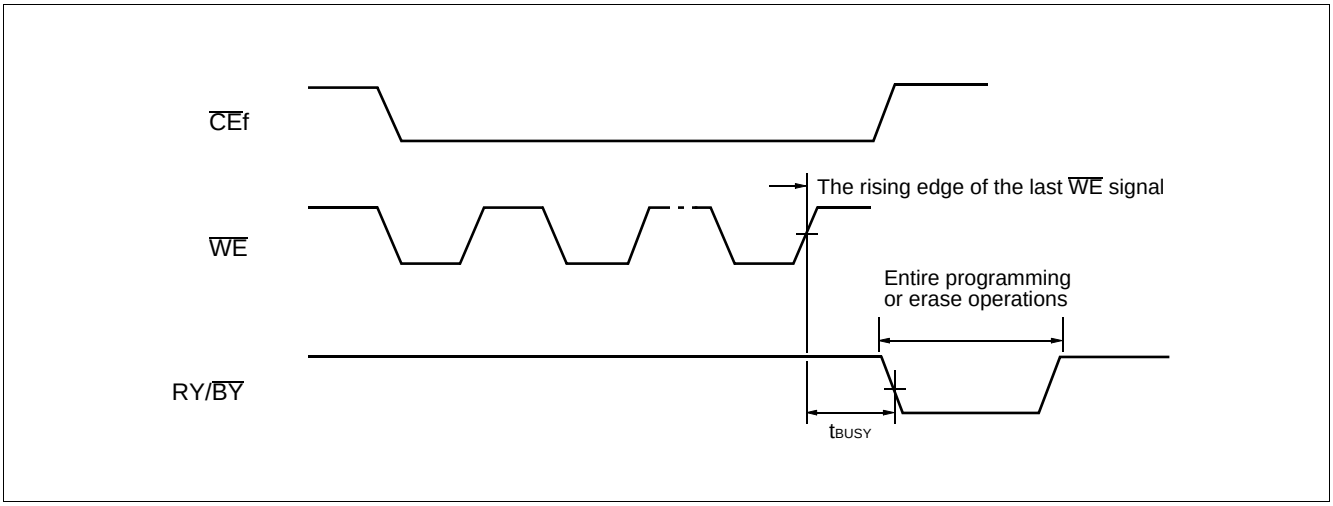
*DQ_7 = Valid Data (The device has completed the Embedded operation.)

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

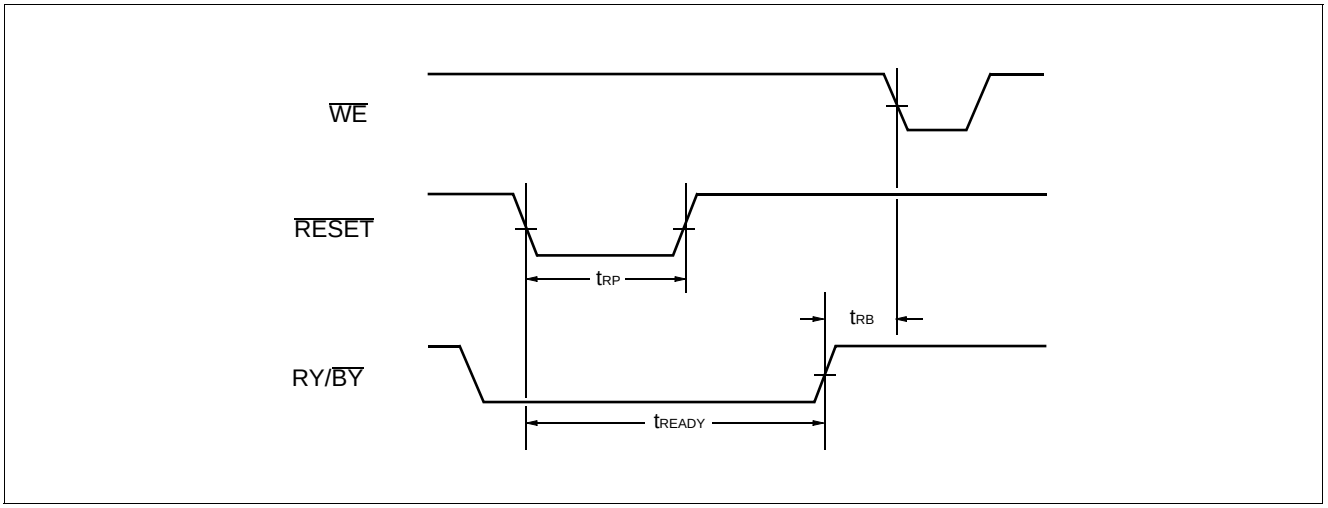


*DQ_6 = Stops toggling. (The device has completed the Embedded operation.)

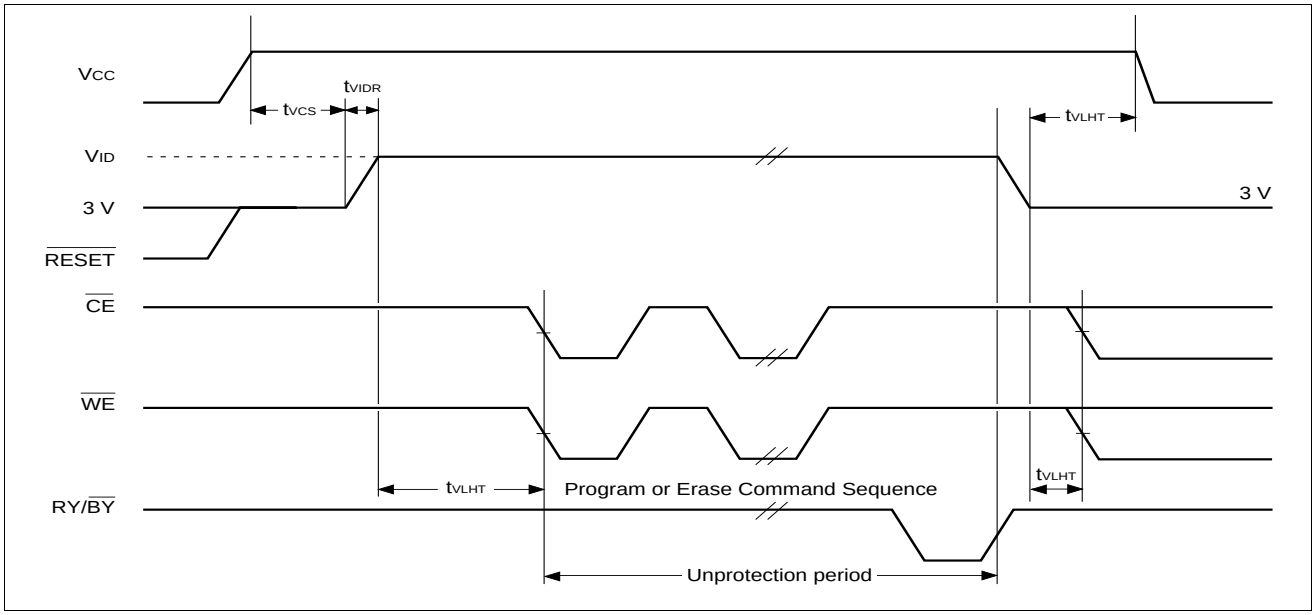
- **RY/$\overline{BY}$ Timing Diagram during Write/Erase Operations (Flash)**



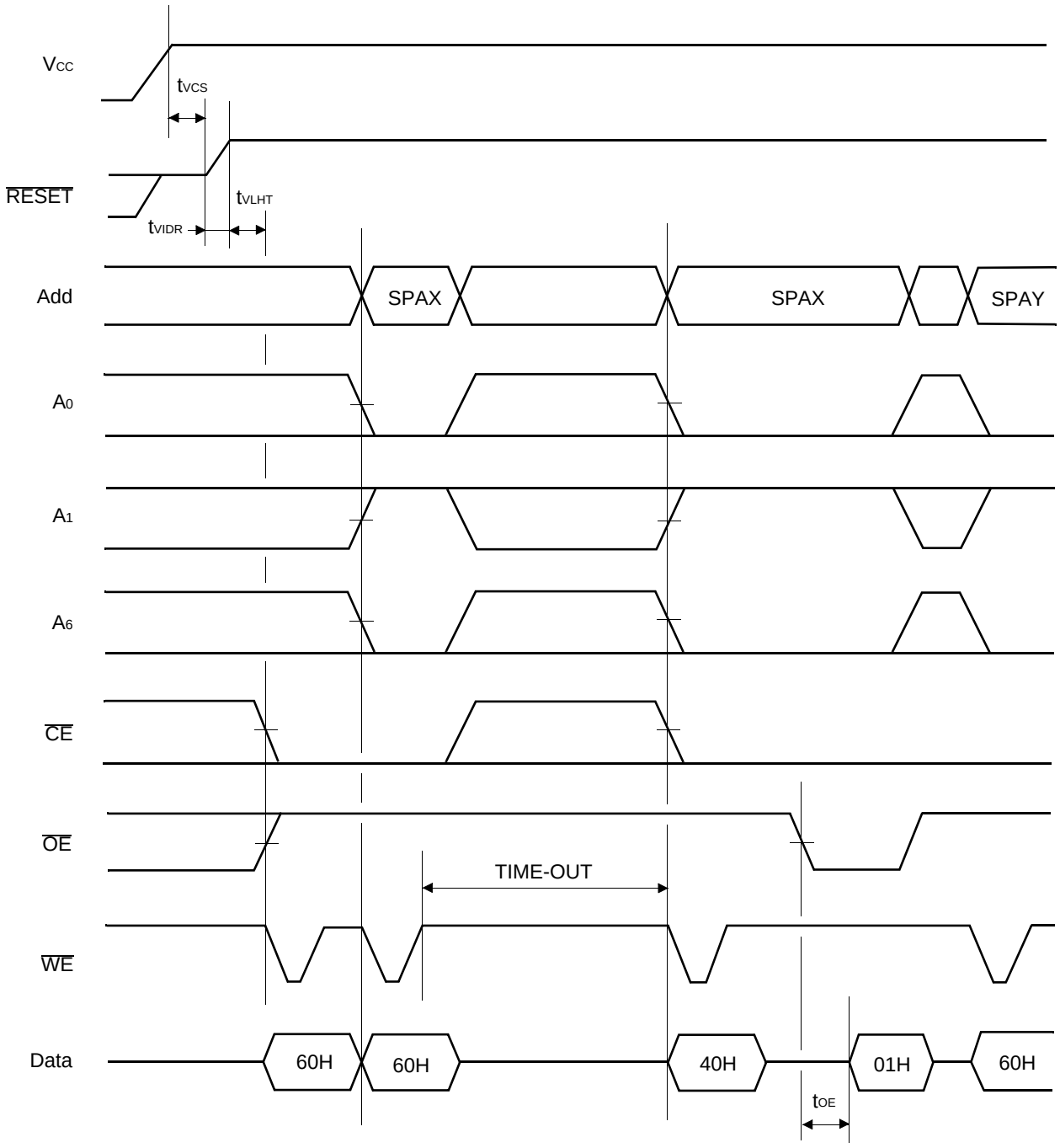
- **$\overline{RESET}$, RY/$\overline{BY}$ Timing Diagram (Flash)**



- **Temporary Sector Unprotection (Flash)**



- **Extended Sector Protection (Flash)**

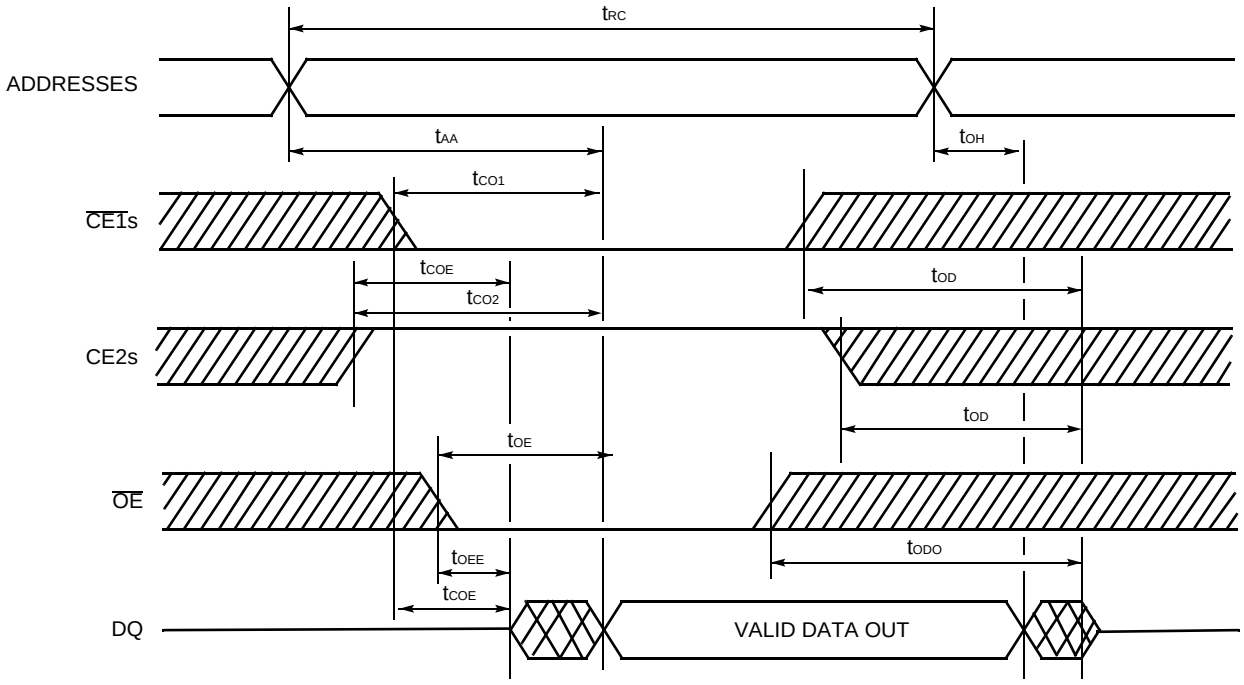


SPAX : Sector Address to be protected
SPAY : Next Sector Address to be protected
TIME-OUT : Time-Out window = 150 µs (min)

- **Read Cycle (SRAM)**

Parameter Symbol	Parameter Description	Min.	Max.	Unit
t_{RC}	Read Cycle Time	100	—	ns
t_{AA}	Address Access Time	—	100	ns
t_{CO1}	Chip Enable ($\overline{CE1}$s) Access Time	—	100	ns
t_{CO2}	Chip Enable (CE2s) Access Time	—	100	ns
t_{OE}	Output Enable Access Time	—	50	ns
t_{COE}	Chip Enable ($\overline{CE1}$s Low and CE2s High) to Output Active	5	—	ns
t_{OEE}	Output Enable Low to Output Active	0	—	ns
t_{OD}	Chip Enable ($\overline{CE1}$s High or CE2s Low) to Output High-Z	—	40	ns
t_{ODO}	Output Enable High to Output High-Z	—	40	ns
t_{OH}	Output Data Hold Time	10	—	ns

- **Read Cycle (Note 1) (SRAM)**

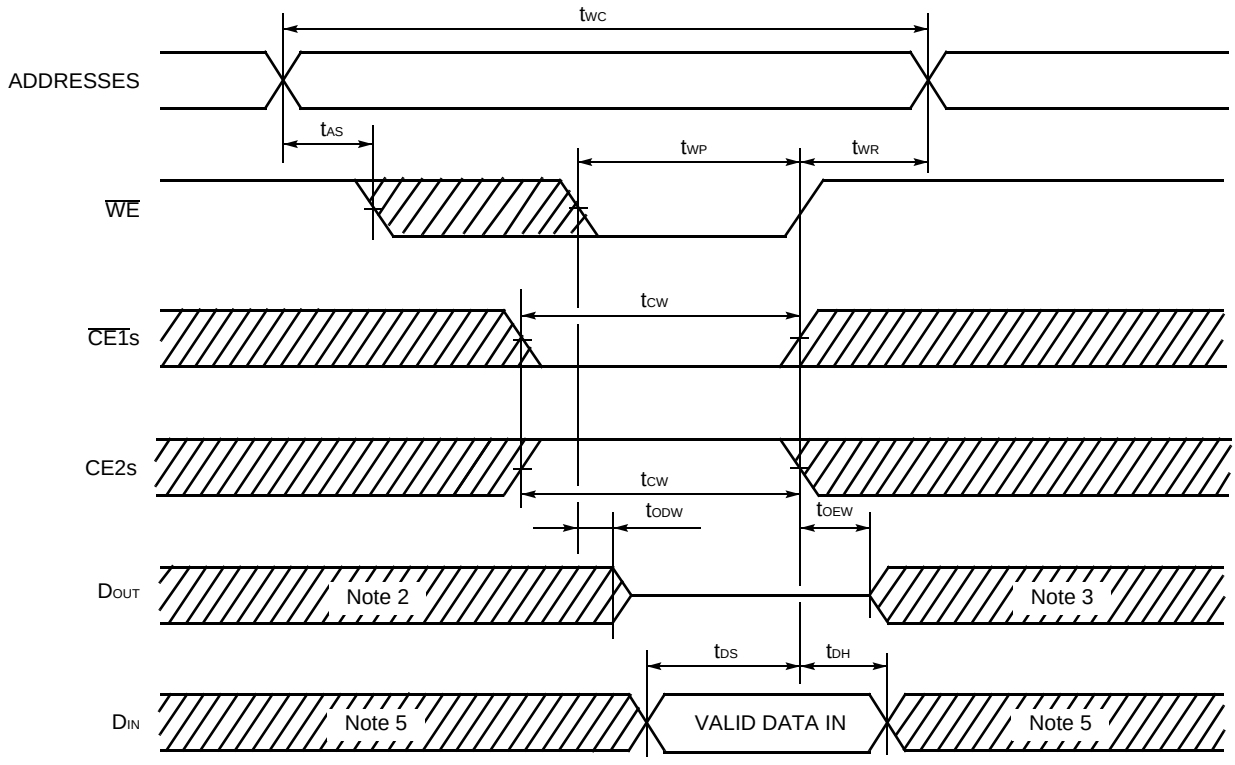


Note: 1. $\overline{WE}$ remains HIGH for the read cycle.

• **Write Cycle (SRAM)**

Parameter Symbol	Parameter Description	Min.	Max.	Unit
t_{WC}	Write Cycle Time	100	—	ns
t_{WP}	Write Pulse Width	60	—	ns
t_{CW}	Chip Enable to End of Write	80	—	ns
t_{AS}	Address Setup Time	0	—	ns
t_{WR}	Write Recovery Time	0	—	ns
t_{ODW}	$\overline{WE}$ Low to Output High-Z	—	40	ns
t_{OEW}	$\overline{WE}$ High to Output Active	0	—	ns
t_{DS}	Data Setup Time	40	—	ns
t_{DH}	Data Hold Time	0	—	ns

• **Write Cycle (Note 4) ($\overline{WE}$ control) (SRAM)**



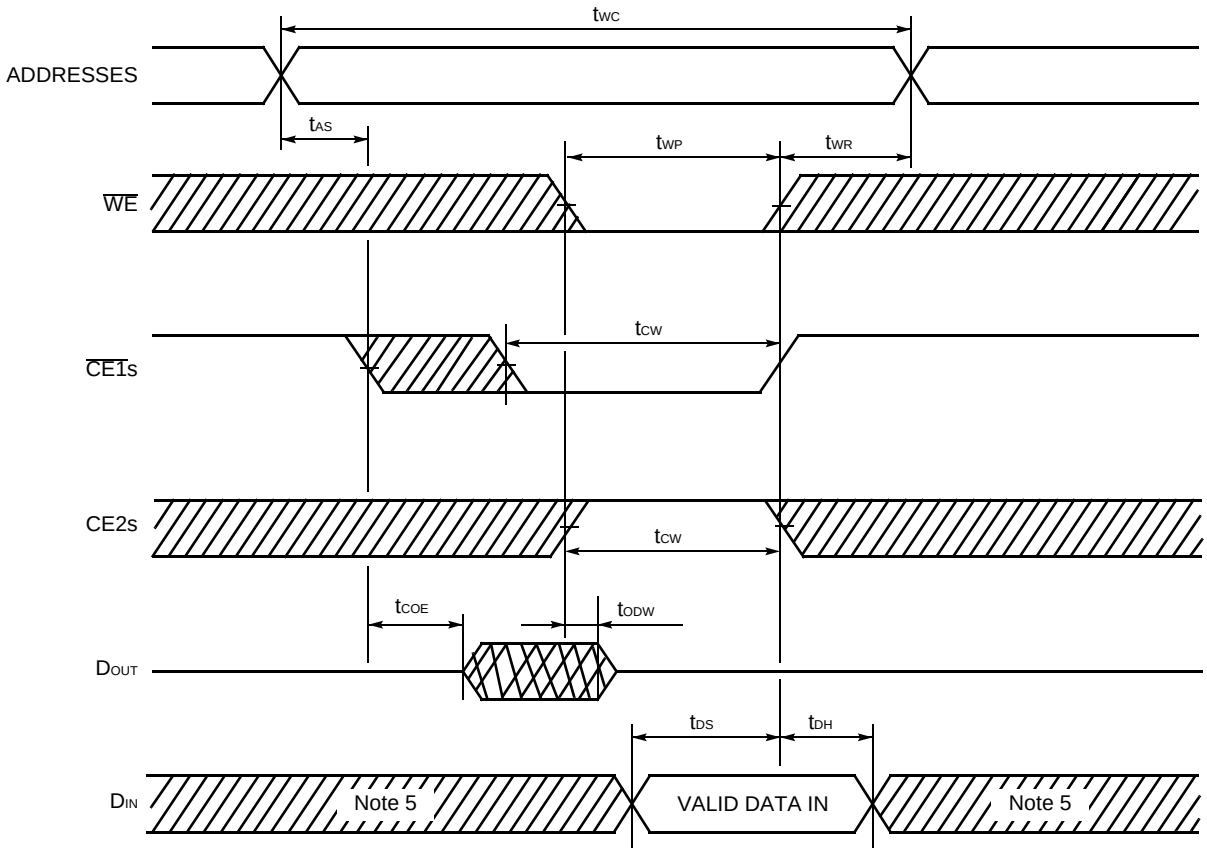
Notes: 2.If $\overline{CE1}$s goes LOW (or CE2s goes HIGH) coincident with or after $\overline{WE}$ goes LOW, the output will remain at high impedance.

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

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

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

- **Write Cycle (Note 4) ($\overline{CE}$1s control) (SRAM)**



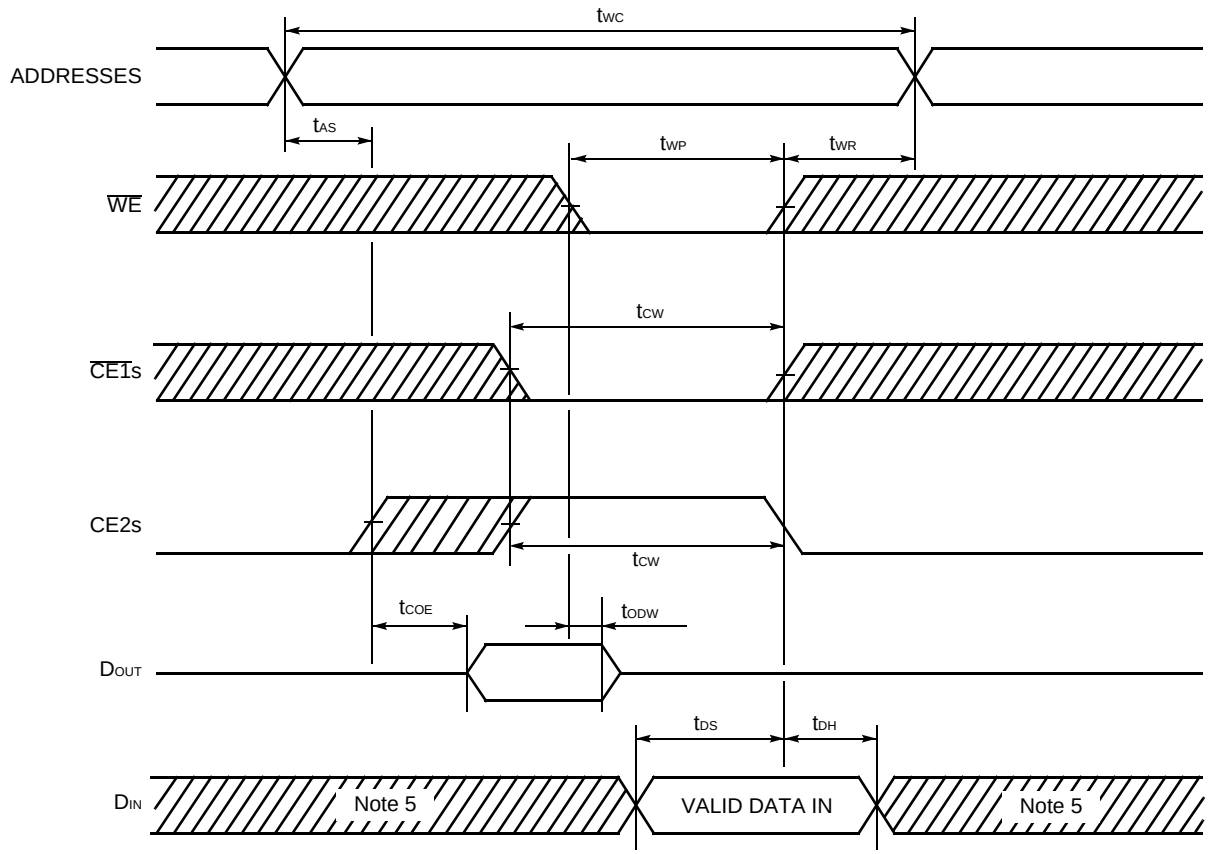
Notes: 2.If $\overline{CE}$1s goes LOW (or CE2s goes HIGH) coincident with or after $\overline{WE}$ goes LOW, the output will remain at high impedance.

3.If $\overline{CE}$1s goes HIGH (or CE2s goes LOW) coincident with or before $\overline{WE}$ goes HIGH, the output will remain at high impedance.

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

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

- **Write Cycle (Note 4) (CE2s Control) (SRAM)**



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

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

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

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

■ ERASE AND PROGRAMMING PERFORMANCE (Flash)

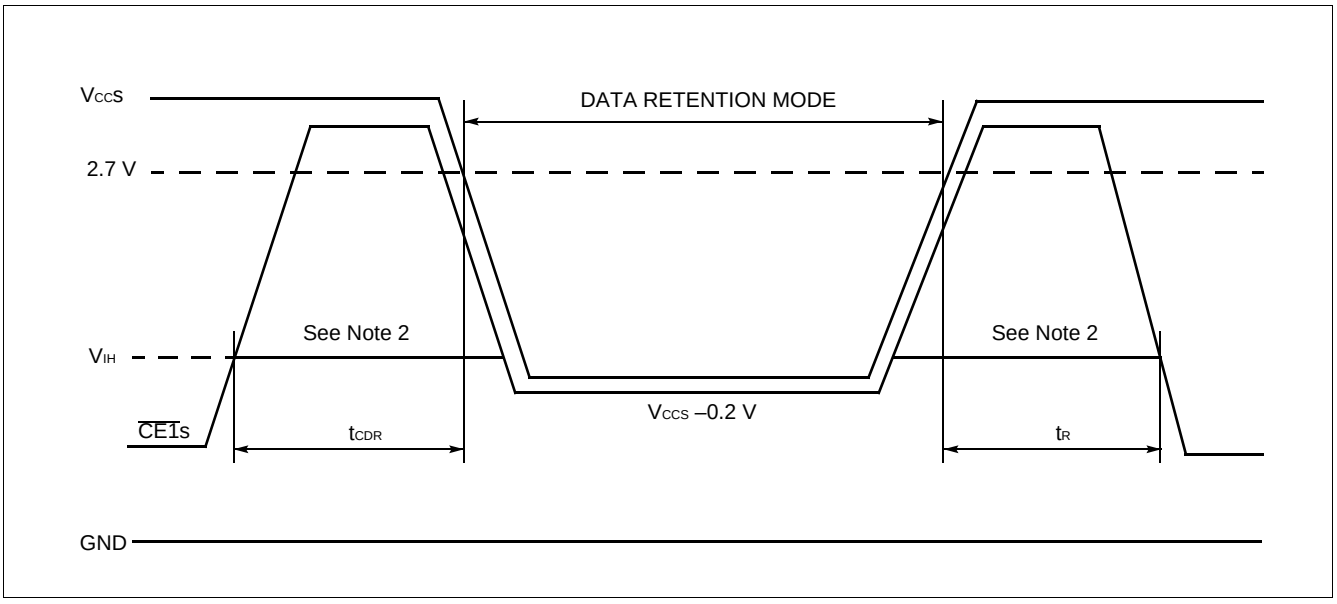
Parameter	Limits			Unit	Comment
	Min.	Typ.	Max.		
Sector Erase Time	—	1	15	sec	Excludes programming time prior to erasure
Programming Time	—	16	5,200	µs	Excludes system-level overhead
Chip Programming Time	—	16.8	100	sec	Excludes system-level overhead
Erase/Program Cycle	100,000	—	—	cycles	

■ DATA RETENTION CHARACTERISTICS (SRAM)

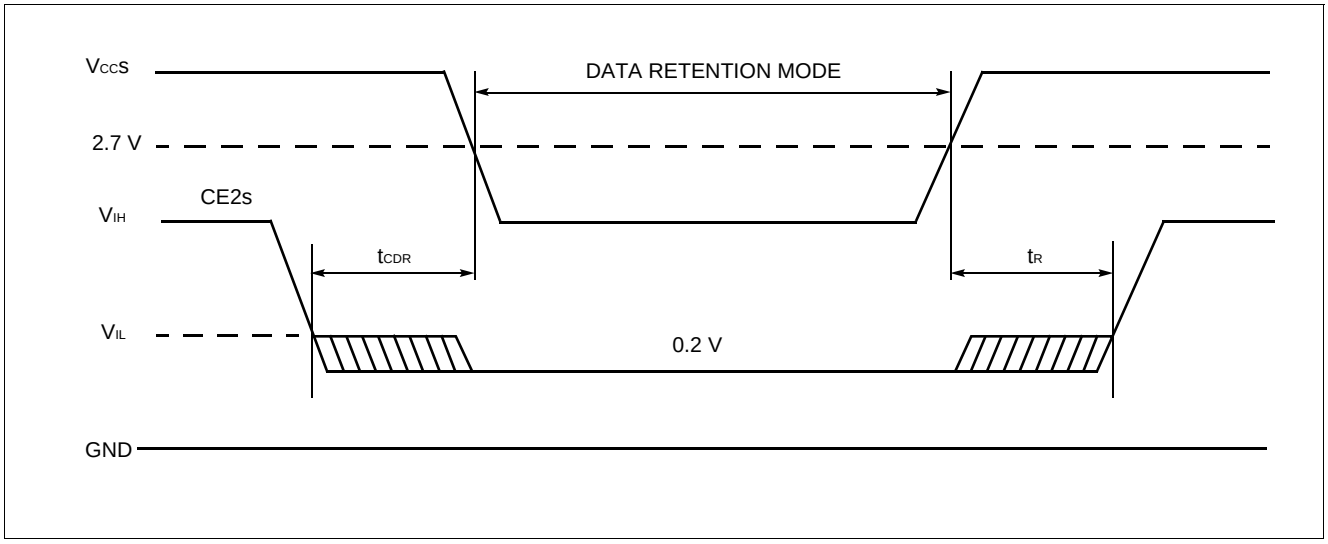
Parameter Symbol	Parameter Description		Min.	Typ.	Max.	Unit
V_{DH}	Data Retention Supply Voltage		2.0	—	3.6	V
I_{DDS2}	Standby Current	V_{DH} = 3.0 V	—	—	50*	µA
		V_{DH} = 3.6 V	—	—	60	µA
t_{CDR}	Chip Deselect to Data Retention Mode Time		0	—	—	ns
t_R	Recovery Time		5	—	—	ms

* : 5 µA (Max.) at T_A = –20°C to +40°C

- **$\overline{CE1}$s Controlled Data Retention Mode (Note 1)**



- **CE2s Controlled Data Retention Mode (Note 3)**



Notes: 1. In $\overline{CE1}$s controlled data retention mode, input level of CE2s should be fixed Vccs to Vccs-0.2V or Vss to 0.2V during data retention mode. Other input and input/output pins can be used between -0.3V to Vccs+0.3V.
2. When $\overline{CE1}$s is operating at the V_{IH} min. level (2.2 V), the standby current is given by I_{SB1}s during the transition of V_{CC}s from 3.6 to 2.2 V.
3. In CE2s controlled data retention mode, input and input/output pins can be used between -0.3V to Vccs+0.3V.

■ PIN CAPACITANCE

Parameter Symbol	Parameter Description	Test Setup	Typ.	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0	T.B.D	T.B.D	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0	T.B.D	T.B.D	pF
C_{IN2}	Control Pin Capacitance	V_{IN} = 0	T.B.D	T.B.D	pF

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

■ HANDLING OF PACKAGE

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

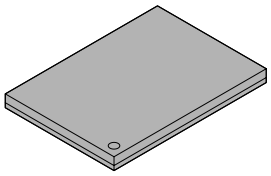
■ CAUTION

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

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

■ PACKAGE

48-pin plastic FBGA

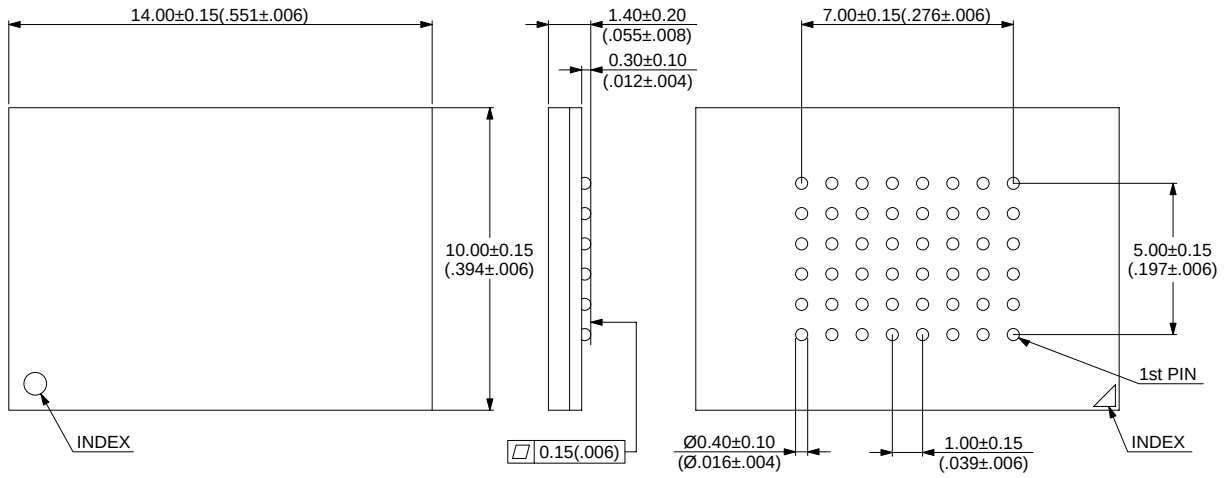


(BGA-48P-M10)

■ PACKAGE DIMENSIONS

48-pin plastic BGA
(BGA-48P-M10)

Note: The actual shape of corners may differ from the dimension.



Dimension in mm (inches).

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